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Educational implications for integrated crop and livestock farming systems research and development in Boone and Story County, Iowa

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Educational implications for integrated crop and livestock farming systems research and development in Boone and Story County, Iowa

by

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INTRODUCTION

Farming Systems Research and Development (FSR&D) has evolved in recent years as an approach aimed at developing changes to existing farming systems to benefit small-scale farmers. At the turn of the century, farmers constituted over 90 percent of the labor force in the United States. America has prospered for over 200 years and agriculture has been one of the major reasons for that prosperity. Today, farmers represent less than 3.5 percent of the labor force. The number of people involved in farming has decreased and the family farm is threatened with extinction (Cheatham, 1985).

Historically, little research has been done with interacting crop/livestock components of farming systems. Zandstra (1982) stated that considerable research has been done on separate crop and livestock production systems. The last decade witnessed the acceptance of farming systems research and development as an effective approach to agricultural research problems.

In many countries, FSR&D has been considered a valuable research approach to the adaptation of agricultural technologies appropriate to the circumstances of small farmers. International donor agencies, international and national research centers, and government agencies have invested immensely in both human and financial resources toward FSR&D (Cormick and Alberti, 1986).

The United States Agency for International Development (USAID) funded a farming systems support project with increased communication between researchers (Zandstra, 1986). However, projects employing this approach neglected the livestock subsector and focused on the cropping component of the farming system (Bernsten et al., 1984). Integrating the livestock component into farming systems research was undertaken by the North Florida Farming Systems Research and Extension Project to "identify specific problems within farming systems, develop alternative solutions to those problems, and test those solutions under farm conditions" (Swisher et al., 1984). A similar approach aimed at integrating crop and livestock enterprises in Iowa may hold the key to a stable and sustainable farming system.

Crop and livestock farming systems research efforts have become a major issue in international agriculture. The Consultative Group on International Agricultural Research (Garrett, 1984) indicated that the major objective of this approach was "the improvement of human welfare through sustainable increased agricultural productivity." It recommended that international and national agricultural research centers evaluate existing farming systems and farmers' aspirations in the context of their physical and socioeconomic environments. This trend would help to orient agricultural research by improving problem identification, designing new and/or improved production systems, conducting and evaluating on-farm research, and assessing the impact of recommended technologies on small-scale producers (Garrett, 1984).

According to the 1982 U.S. Census of Agriculture, Iowa, as of 1982, had 115,413 farms. The number of farms has been decreasing at an annual rate of 4.9 percent since 1978. In 97 counties, the number of farms declined ranging from 4 to 149 each year. Ten counties had less than 25 fewer farms in 1982 than they did in 1978. Farm numbers were down by 25 to 49 in 27 counties, 50 to 74 in 29 counties, and by 75 to 99 in 23 counties. A total of 44 counties lost farms below the state average of 4.9 percent (Goudy and Lasley, 1984).

According to the U.S. Census of Agriculture (1982), Boone County had 1,153 farms in 1982 compared to 1,249 in 1978. Similarly, Story County had 1,248 farms in 1982 as opposed to 1,330 in 1978. The reduction in number of farms in the counties corresponds with the number of farmers and farm families going out of business in Iowa. This trend was the result of the farm crisis that put the family farm in jeopardy of becoming extinct (Cheatham, 1985).

The area of principal crops (corn, soybeans, sorghum, wheat, and oats) planted or grown in Iowa in 1983 totaled 310 million acres (126 million hectáres), a reduction of 52 million acres from 1982. The major crops showing a decrease in planted acreage from 1982 were: corn, 26 percent; sorghum, 27 percent; wheat, 12 percent; and soybeans, 11 percent (Iowa Agricultural Statistics, 1984). Only oats were up by 42 percent, mostly on land devoted to conservation under the pay-in-kind program.

Research and education (Cheatham, 1985) were blamed for the farm foreclosures that punctuated the American agricultural landscape in recent years. Other writers (Bowen, 1986) compared the present farm crisis to the situation caused by the Great Depression of the late 1920s and early 1930s. However, research and education of the farmer are at the central core of solutions to this problem.

Garrett (1984) stated that "what is available is actually inappropriate for limited resource farmers." Encouraging the identification of relevant and researchable problems through Farming Systems Research can facilitate the development of technologies appropriate to small-scale farmers (Garrett, 1984).

Gardner (1985) stated that traditional programs, which rely on commodity supply and demand manipulation, no longer work well. This was as a result of a substantial number of farms facing severe financial stress, the decline in the average value of U.S. farmland per acre, low farm commodity prices, and government support for farm prices and income (Gardner, 1985). Simply put, existing farming systems in Iowa have shown weaknesses in terms of providing maximum benefits or returns of resources for farmers. This situation led to an increasing demand for diversification in agricultural production and marketing (Ubadigbo and Gamon, 1988; Gamon and Ubadigbo, 1987).

The need for a farming systems approach to technology development was spawned by the increasing concern about the social inequities in the distribution of the public investment in research and extension. There is also a growing awareness that farmers should be allied as partners with extensionists and researchers due to the realization that technical-proposed solutions to farmers' existing crop and livestock systems did not improve the situation of the farm household (Galt and Mathema, 1987). However, most early farming systems work involved the need to understand more fully the small-scale, limited resource, family farm.

The FSR&D approach to agricultural problems depicts the hierarchy of constraints within an agricultural system, and how the constraints interact on the farm and on a particular crop or livestock (Hildebrand, 1986, p. 17). This study is directed toward classifying farmers in Boone and Story counties of Iowa into a recommendation domain. Grouping farmers into a recommendation domain helps to reduce the natural heterogeneity of small farmers with common characteristics, and potential becomes one of the focal points of this study.

The purpose of this study was to determine the relevant educational program needs of the existing farming systems in Iowa, identify ways of improving them, and provide information as to the farmers' perceptions about conducting farming systems research on integrated crop and livestock enterprise.

The objectives of this study were to:

1. Determine farmers' perceptions on ways to improve the existing farming systems and how best the livestock enterprise could be incorporated into the existing system.
2. Identify farming systems educational program areas, sources of farming information, and the extent of cooperation between farmers and public agencies.
3. Identify the deficiencies and constraints of the existing farming systems as perceived by farmers with implication for Agricultural Education.

LITERATURE REVIEW

Historical Background of Farming Systems Research (FSR)

Farming systems research ideology existed in the United States in the late nineteenth and early twentieth centuries, during which:

> . . . many agricultural scientists in the United States and Europe spent much of their time out on farmers' fields observing and interviewing farmers. . . . Scientists recognized that their contributions would have to be based upon an intimate knowledge of farming systems actually in use (Boynton, 1983, p. 154).

In the United States, agriculture is the biggest industry with assets totaling more than $1 trillion. There are about 2.5 million farmers in America, with over 22 million involved in agriculturally related industries. Farmers involved in agricultural production are divided by geography, outlook, and interest (Gorman, 1987).

In Iowa, agriculture has graduated from breaking the soil with a plow pulled by a team of horses under subsistence agriculture to a highly technologically advanced farming system. Legislative actions by the United States Congress have paved the way to present advances in agriculture.

Gorman (1987) stated that farming methods changed a great deal during the 1920s, 1930s and 1940s caused by the increasing use of fertilizers, insecticides, and herbicides, followed by innovations in farm machinery. The shift from horse-drawn machinery to tractors allowed many more crops to be planted in shorter amounts of time. The land used for grazing the horses and mules that pulled the farm machinery was plowed up and planted (Gorman, 1987). Only the more successful farmers could afford the tractors. Smaller farmers who could not afford the new machines could not compete. As a result, many small farms were sold and absorbed into larger, more prosperous operations (Gorman, 1987).

Gorman (1987) estimated that between 1954 and 1960 the number of farmers decreased by over 911,000 farms. Between 1960 and 1970, there was a remarkable decrease in number of small farms, followed by a continued increase in size and efficiency of bigger farms. This change in the structure of U.S. agriculture had a significant impact on the farm family (Deseran et al., 1984). The proportion of farm operators and their family members who are employed off the farm increased. This shift in U.S. agricultural system was:

> . . . attributed to such factors as escalating operating costs and increasing off-farm employment opportunities, has resulted in changes that are not just internal to the family or even the agricultural economic sector, but involves an integration of the farm family into the larger socioeconomic structure (Deseran et al., 1984).

Deseran and others stated that farming:

> . . . particularly those of smaller operations which comprise a large percentage of U.S. farms, is often at the minimum a two-person operation requiring commitment of time and loyalty from both spouses.
>
> The success of such operations often depends on the contribution of family members in terms of unpaid labor, financial solvency--especially for younger families--and is becoming increasingly dependent upon nonfarm sources of income (Deseran et al., 1984).

The history of the agricultural system in the U.S. cannot be complete without mentioning legislative milestones. One was the establishment of the U.S. Department of Agriculture in 1862. The land-grant colleges created in the same year marked the first step in the development of the

U.S. agricultural systems (Lionberger and Gwin, 1982; Gorman, 1987). The newly created land-grant colleges were charged with the responsibility of "teaching agriculture and mechanical arts to all students who wished to obtain a college education" (Lionberger and Gwin, 1982, p. 28).

The Hatch Act of 1887 established the agricultural experiment stations in each state to generate new technologies. The Smith-Lever Act of 1914 created the Cooperative Extension Service and was charged with the responsibility of dissemination of knowledge about the new technologies (Gorman, 1987). However, advancements in agriculture nurtured an increasing concern as to whether future demands could be met with the current technologies (Canter, 1986).

Some authors identified four technological eras in U.S. agriculture (Canter, 1986). The first era, the American Revolution to the Civil War, was dominated by hand power. A massive search for better implements and more efficient method of farming followed after the Civil War. Hand-powered tools and machinery were invented, and improved farming practices were adopted. Agricultural productivity increased between 1770 and 1800 and leveled off in the 1830s.

Another era between the Civil War and World War I marked the replacement of hand tools by horse-powered machines (Canter, 1986). Horse-drawn machines such as reapers, grain drills, corn shellers, hay-bailing presses and cultivators of various types were invented (Canter, 1986). These inventions moved American agriculture into its first technological revolution.

As this era ended, a new era emerged which could be associated with the use of mechanical power in agriculture. This period corresponded with time of increasing demand for food and fiber. The last era was the science power which witnessed the growth in agricultural productivity through research in genetics, chemical, and mechanical engineering (Canter, 1986).

The rate of agricultural productivity growth slowed down in the 1960s. From 1939 to 1960, the total factor productivity as measured by output per unit of all inputs increased by 2.0 percent annually, while labor productivity grew at 5.9 percent. Between 1960 and 1970, the total factor productivity increased by only 0.9 percent, while labor productivity rose by 5.6 (Canter, 1986). Canter (1986) emphasized that developing technology which can increase food production without serious side effects would continue to be a challenge. The subsequent slowdown in agricultural productivity created an adverse effect on the American farming system (Gorman, 1987). This trend in agricultural systems of the United States had from time to time prompted legislative interventions.

The Agricultural Adjustment Act of 1933 encouraged farmers to produce less food by reducing the number of acres under cultivation (Gorman, 1987). The Frazier-Lemke Farm Bankruptcy Act of 1934 allowed farmers a moratorium on foreclosures. This Act was declared unconstitutional in 1935. The Farm Mortgage Moratorium Act of 1935 provided for a three-year moratorium, which saved many thousands of farmers from losing their farms (Gorman, 1987). The controversy as to whether farmers with financial difficulties should be helped by the government lingers on to this day (Gorman, 1987).

All of these developments encouraged the identification and evaluation of emerging technologies in 1980 and 1981 through the Delphi study. In the Delphi study, 250 agricultural researchers were mandated to identify and rank order important agriculture production technologies which they believed should be commercialized by the year 2000 (Canter, 1986). The researchers focused their attention on technology clusters that satisfied two criteria:

1. Technologies in the cluster would have a significant impact on agricultural productivity, resource utilization, and environmental condition; and
2. The technology has at least 50 percent chance of being commercialized by the year 2000 (Canter, 1986, p. 23).

The most important emerging agricultural production technologies were crop residues and animal waste utilization and multiple cropping. These two emerging technologies were, respectively, scored with:

> . . . a relative importance of technology cluster productivity of 7 and 9; resources of 8 and 6 and environment of 8 and 7 (Canter, 1986, p. 23).

Today, crop residues and animal waste utilization technology are being developed for animal feed and a biomass for energy conversion. The current food production system in the U.S. is highly mechanized and energy intensive. Canter (1986) noted that the emphasis in U.S. agriculture today is to raise output per unit resource input and to reduce the constraints imposed by inelastic supplies of land, water, fertilizer, pesticide, and energy (Canter, 1986). He concluded that the constraint to increase agricultural production, apart from technological limitations, included:

1. Loss of prime farmland due to urban sprawl;
2. Multiple influences of a reduction in energy supplies and rising energy prices;
3. Influence on irrigation due to rising water prices; and
4. Multiple influences of conservation and environment improvement policies (Canter, 1986, p. 11).

Other writers reported that the ecologists began in the 1950s to analyze the flow of energy in ecosystems. An ecosystem was defined as an "environmental unit containing plants and animals" integrated by means of interdependent relationships to produce a balance of nature. In 1960, researchers began to analyze agricultural systems in terms of energy flow. This move was later hastened in 1971 by the sudden increase in oil prices, indicating the dependence of advanced methods of farming on energy from fossil fuel.

International Approach to Farming Systems Research

The quest for relevant technology gave birth to Farming Systems Research (FSR) to neutralize the development slogan of the '80s--"basic human needs" and "growth with equity." Farming systems research and development (FSR&D) evolved as people started thinking about agriculture and technology development, coupled with the fact that previous strategies to improve the livelihood of small farmers failed, especially in the less developed countries of the world (Norman, 1980).

In the United States and around the world, the major question relating to this study is (The World Food Institute, Eighth Annual Edition, 1988, p. 3):

> What U.S. and world economic policies are appropriate in dealing with the problems of sluggish growth in global agricultural trade, food security, and international trade?

Research on farming systems has developed in the last decade and is being pursued in Africa, Asia, and Latin America at regional, national, and international institutions. Among the international research institutions involved in farming systems research are the International Rice Research Institute (IRRI) in the Philippines; the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) in India; the International Institute of Tropical Agriculture (IITA) in Nigeria; and Centro International de Agricultural Tropical (CIAT) at Colombia.

According to Norman (1980), the farming system approach adopted by these institutions consisted of two basic types--the UPSTREAM and DOWNSTREAM approaches--which were recommended by the Technical Advisory Committee (TAC) in 1978 (Norman, 1980). The upstream approach utilizes research from experiment stations to find prototype solutions to the major constraints on agricultural improvement in a relatively large area. The downstream approach is basically a farm level approach in which farmers and a multidisciplinary research team work together to diagnose, design, modify, and improve farming systems in a given area. The latter approach uses information from the former (experiment station and commodity research programs) to design improvement in a particular farming system at the completion of analyzing the major constraints (Norman, 1980).

Stressing the need for FSR&D, Harwood (1982a) stated that FSR applies to both agriculture in both developed as well as developing nations. He argued that many resource-efficient technologies are concerned with the complementarity and integration of enterprises on a farm for efficient farm for efficient use of scarce farm resources. He indicated that:

> The knowledge of these interactions and the ability to enhance their effects are the reality of FSR. It implies a farmer involved approach . . . an understanding of component technologies and their interaction with gradients of the physical, biological, and socioeconomic environments of a farming system (Harwood, 1982a, p. 6).

He emphasized that the greatest gain in resource use efficiency was that of effective crop-animal interactions of feed, power, and nutrient cycling. He then stated that:

> The emerging farmer-participant farming systems methodologies are, for the first time, permitting us to diagnose the more complex farm development problems and to accurately target technologies to meet those needs (Harwood, 1982a, p. 15).

According to Jones and Wallace (1986), differing approaches to FSR were developed almost simultaneously at different national, regional and international research centers. Different variants such as Farming Systems Research and Extension (FSR&E) and Farming Systems Research and Development (FSR&D) were recognized depending on the problem focus (Jones and Wallace, 1986).

The cropping system approach was developed at IRRI as the need for combined crop production arose in Southeast Asia, while in Guatemala a similar FSR approach was being conducted at the ICTA (Instituto de Ciencia y Tecnologia Agricola (ICTAT)) (Jones and Wallace, 1986). This approach spread like wildfire among international research centers, which resulted in the production of an encyclopedic review of FSR methodologies by Shaner, Philipp and Schmehl in 1982 (Jones and Wallace, 1986).

Norman (1982) tried to elucidate on the emergence of different farming systems when he stated:

> A farming system adopted by a given farming household results from its members, with their managerial know-how, allocating the three factors of production; i.e., land, labor, and capital, to which they have access, to three processes (crops, livestock, and off-farm enterprises) in a manner which, within the knowledge they possess, will maximize the attainment of the goal(s) for which they are striving (Norman, 1982, p. 1).

Today, farmers in both developed and developing countries have become adept in the management of new techniques and inputs and in most cases actively involved in informal experimentation processes to determine optimal combination for their own agricultural, economic and social conditions. Some people believed that the development of FSR could be attributed to the recognition of the technical expertise of farmers as well as the increasing awareness and respect by development technicians for locally developed production system (Harwood, 1982a). Boynton (1983) indicated that the national policy and programs, which emphasized production agriculture for specific crops and animal products, ignored emphasis on improved management systems and consequently did not "recognize the special needs of small farmers or provide incentives necessary to get them to participate in the development of programs" (Boynton, 1983, p. 262). He maintained that:

> The development of improved farming system for small farmers depends upon a holistic approach to the problems of fitting the farm enterprises into the total environment of the farmer (Boynton, 1983, p. 262).

Farming Systems Research and Development Defined

For the purpose of this study, it is important to define farming systems as a whole and outline reasons for its adoption as a reasonable approach to the constraints of small farmers. According to Norman

(1982), the term farming systems research (FSR) has been loosely applied. Certain programs are called FSR that are not FSR. Some programs are FSR, but are not called farming systems research. He outlined the characteristics of FSR which included:

> (a) The farm as a whole is viewed in a comprehensive manner.
> (b) The choice of priorities for research reflects the initial study of the whole farm.
> (c) Research on a farm subsystem is legitimate FSR, provided the connections with other subsystems are recognized and taken into account.
> (d) Evaluation of research results explicitly takes into account linkages between subsystems (Norman, 1982, p. 3).

The scarcity of farming systems research literature was blamed on:

> 1. Many scientific workers have proceeded from the viewpoint and assumptions of conventional agriculture;
> 2. Many scientific workers have begun with the assumption that organic agriculture does not exist except in a backyard garden setting; and
> 3. Many workers started with false hypotheses . . . that organic agriculture is based on the assumption that there is a difference in the nitrate ion derived from synthetic rather than a natural source (Harwood, 1982a, p. 2).

The available literature contained a considerable variation in FSR definitions and utilization (Gerhart, 1986). Many agricultural researchers considered farming systems research as a system approach to agricultural production (Grigg, 1974; Ruthenberg, 1976; Norman, 1980; Gerhart, 1986; Fernandez, 1988; Shaner et al., 1982).

A system was defined as "any set of elements or components that are interrelated and interact among themselves" (Norman, 1980). Based on this simple definition, farming systems became a resultant effect of a complex interaction of a number of interdependent components with the farmer as the central figure (Norman, 1980; Fernandez, 1988). Norman

(1980) also indicated that:

> A specific farming system arises from the decisions taken by a small farmer or farming family with respect to allocating different quantities and qualities of land, labor, capital, and management to crop, livestock, and off-farm enterprises in a manner which, given the knowledge the household possesses, will maximize the attainment of the family goal(s) (Norman, 1980, p. 2).

Farming systems research and development (FSR&D), as a system:

> . . . recognizes and focuses on the interdependencies and interrelationships between the technical and human elements in the farming system. The primary aim of the FSR approach is to increase the overall efficiency of the farming system; this can be interpreted as developing technology that increases productivity in a way that is useful and acceptable to the farming family, given its goal(s), resources and constraints (Norman, 1980, p. 5).

Boynton (1983, p. 253) accepted the above definition of FSR&D in "Higher-Yielding Human Systems for Agriculture." In "Farming Systems Research, Productivity, and Equity," Gerhart (1986) acknowledged the early definitions of FSR made by the International Center for Agricultural Research in the Dry Areas (ICARDA), which defined farming systems research as:

> . . . a process that identifies problems limiting agricultural productivity, and then searches for solutions for problems. This process recognizes the resources and constraints of the farming families and seeks solutions that are relevant, useful, and acceptable to these families. Research is undertaken by multidisciplinary team of scientists that interact continually with the farmers for whom the research is intended. This approach should ensure that research produces appropriate technologies and therefore will be more easily and quickly adopted (Gerhart, 1986, p. 62).

Shaner et al. (1982) defined FSR&D as agricultural research and technology development that views the whole farm as a system and focuses on:

1. The interdependencies among the components under the household control; and
2. How these components interact with the physical, biological, and socioeconomic factors not under the household control (Shaner et al., 1982, p. 1).

McDowell and Hildebrand (1980) indicated that attempts have been made to identify or systemize the prevailing farming systems of regions and of the world. They stated that farming-system types consist of "a small number of major or dominant crops and numerous minor crops that fit around them" (McDowell and Hildebrand, 1980, p. 9).

Farming Systems Research and Development Process

Discussing about the research process in FSR, Jones and Wallace (1986) stated that FSR as an interactive research strategy is characterized by the use of an interdisciplinary team; the integration of experiment station research with socioeconomic investigations, and on-farm trials of technology in the fields. The first stage in FSR consists of defining the project objectives as well as selecting the area for the study. The second stage includes the characterization of a work area which includes regional and intersectional linkages as well as defining the predominant farming systems. Characterization of FSR they said helps to define systems which will influence the primary objective of the project and calls for the inclusion of all the elements of the agroecosystems to eliminate incompatibility during the phase of technology transfer. Another stage in the FSR approach is the design of improved systems directed toward the farms or the target population. The improved system will be applicable to a large number of farms to justify the investment in research (Jones and Wallace, 1986). They stressed validating FSR design as soon as sufficient data regarding the applicability of the technology is available as well as validating the FSR design under field conditions (Jones and Wallace, 1986).

Farming systems researchers warned against the use of secondary data. In identifying farmers' circumstances, Winkelmann and Moscardi (1982) stressed the dangers of using secondary data to frame general impression which they said is rarely sufficiently detailed to orient research toward improved technology. They suggested that such detailed information requires first-hand knowledge of circumstances and problems. They advocated exploratory survey work in the environment for which technology is to be developed including:

> 1. Informal but organized discussions with farmers and others familiar with the environment. The effort involves both discussion and observation and focuses on production practices and problems, markets for production and input, and important competing activities; [and using the]
> 2. Secondary data, the knowledge of researchers and the results of the exploratory survey . . . to describe a tentative recommendation domain (i.e., sets of farmers whose natural and economic circumstances are sufficiently similar that a given technology will be relevant to each farmer within a set (Winkelmann and Moscardi, 1982, p. 37).

Although FSR received acceptance among farming systems researchers, many researchers generally agree that farming systems research should not be a substitute for conventional commodity-oriented agricultural research but complementary to it (Norman, 1980; Boynton, 1983). Observations in recent years showed that successful farming systems research involves four stages:

a. Description or diagnosis of present farming systems;

b. Design of improved systems;
c. Testing of the improved systems; and
d. Extension of improved systems (Boynton, 1983, p. 253).

Figure 1 shows the schematic representation of some of the farming systems with implications for plant and animal research (Boynton, 1983, p. 254).

Boynton (1983) indicated that the first three of these four stages were encompassed in the ten steps described for the Central American Small Farmer Cropping Systems Program of 1979. They were:

> (1) Identification of goals and purposes; (2) Selection of areas for study; (3) Inventory of documentary information; (4) Local surveys and case studies; (5) Conceptualization and planning of the research to be done; (6) Farmers' trials; (7) Component experiments and studies; (8) Analysis and interpretation of results; (9) Application of results to planning future work; and (10) Evaluation of research results (Boynton, 1983).

Harwood (1982a) categorized farming systems according to their stage of development and resource use. Others categorized farming systems through the identification of the technical and human elements--both those under farmers' control and those not under his/her control (Norman and Gilbert, 1982). Gerhart (1986) supported the four stages of FSR&D, but added that the testing of innovations should be in the farmers' fields. He emphasized that the introduction of innovation(s) should go together with the necessary infrastructural support such as training, demonstration, supply of inputs, markets, etc. However, he advised that if researchers' new technology could be achieved, they should broaden their research framework to include such factors as:

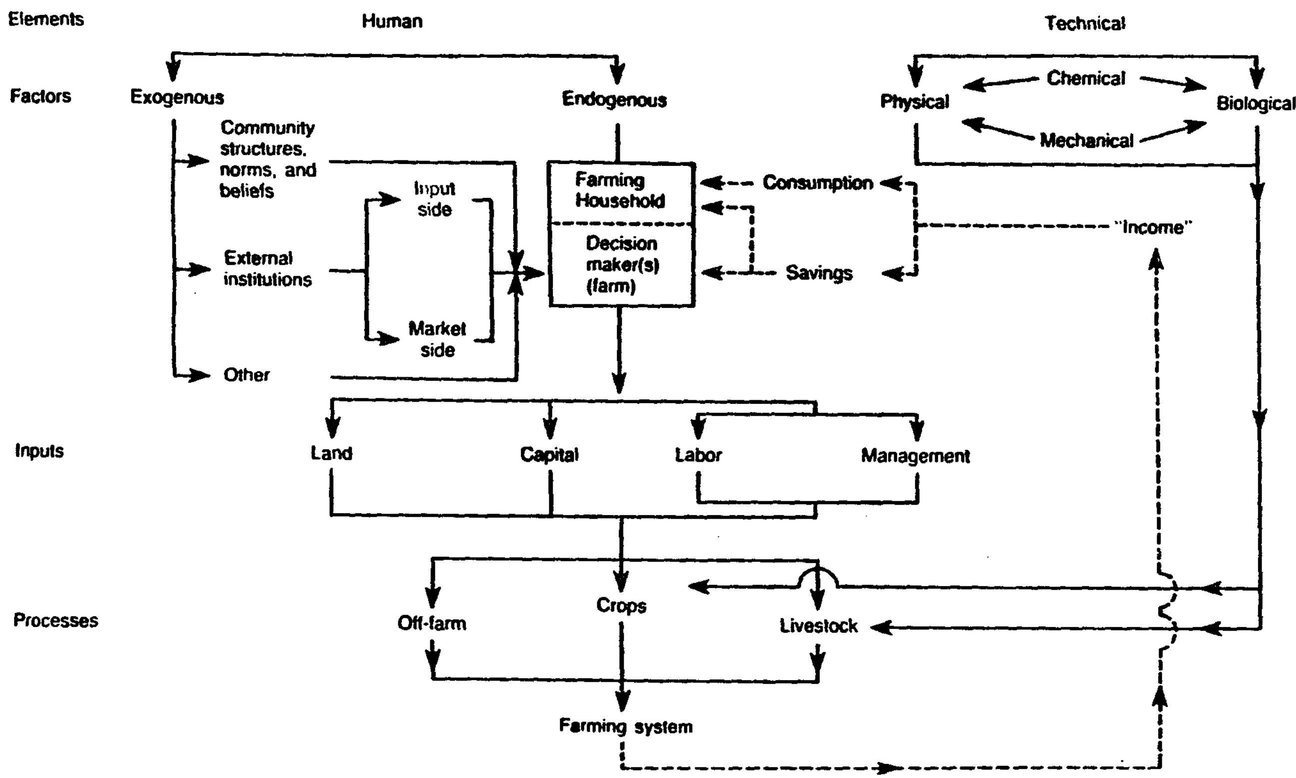

Figure 1. Schematic representation of some farming systems with implications for plant and animal research (from Boynton, 1983, p. 254)

> (1) Family labor utilization; (2) family decision making; (3) the role of livestock in the household economy; (4) the importance of off-farm income and employment; and (5) the disposition of farm products (Gerhart, 1986, p. 58).

Objectives of FSR&D

What are the objectives of farming systems research? This question was posed by Plucknett in 1982 and still remains an issue among farming systems researchers. Plucknett (1982) indicated that one of the major objectives of FSR was to raise farm income. Other objectives include to learn what the farmer is doing as well as "problem identification, and partly to give research direction and programs direction for the future" (Plucknett, 1982, p. 157).

Other researchers stressed that the primary objective of FSR is:

> . . . to improve the well-being of individual farm families by increasing the overall productivity of the FS in the context of the entire range of private and societal goals and given the constraints and potentials imposed by the technical and human elements which determine the existing farming systems (Norman and Gilbert, 1982, p. 19).

Others described integrated farming systems as a wide-open field for multidisciplinary research and stressed that the primary objective of FSR should be the identification of the most profitable crop-animal mixes for specific farming systems.

Norman (1980) emphasized that the holistic nature of FSR separates it from the reductionists' approach used by technical agricultural scientists who tend to study one or two things at the same time while attempting to control other factors. Jones and Wallace (1986) stated that the problem bequeathed to FSR was to construct an integrated picture of peasant production, formulate strategies of integrating the contributions of biological and social scientists at all stages of the research process. This approach helps to ensure that problems were correctly perceived in both technical and social senses. Harwood (1982a) acknowledged the shortcoming of Green Revolution when he recalled the statement by Ponnamperuma in 1979 which stated that "small farmers cannot provide the management inputs required to extract the high yield potential of modern varieties" (Harwood, 1982a).

He stated that the efficiency of resource use will be the game in agricultural development in future years. He reminded researchers that resource-efficient technologies specific to well-defined production environment should be the challenge of today's development team (Harwood, 1982a).

Studies have indicated that earlier approaches to Farming Systems Research and Development (FSR&D) ignored the human element in agriculture through a "top down" management approach which in essence modified the technical elements to fit crops or animals in a given system (Norman, 1980). In contrast, modern FSR&D approaches tend to increase the potential for fitting the crop or animal to the environment (Norman, 1980; Norman and Gilbert, 1982).

Norman and Gilbert (1982) divided environment into two elements--technical and human elements. The technical elements include the types and physical potential of livestock and crop enterprises as well as the physical and biological factors often modified by man through technology development. Norman and Gilbert (1982) argued that a given farming system emerged as a subset of what is potentially possible as defined by technical elements. They characterized human elements into two factors--exogenous factors and endogenous factors. The exogenous factors (the social environment) include all those factors outside the control of the farmer which, when classified under three areas, were:

1. Community structures, norms, and beliefs;
2. External institutions, which include those influencing farming decisions related to supplies of inputs and markets for the farmers' commodities; and
3. Other factors, such as farm location and population density (Norman and Gilbert, 1982, p. 19).

Endogenous factors which include land, labor, capital, and management, on the other hand, are controlled by the farmer who decides on the farming system that will emerge as long as the technical elements and the exogenous factors permit (Norman and Gilbert, 1982). Norman (1980) blamed the conventional research scientist for ignoring the human element through their "top down" approach to technology development. He favored a FSR&D approach because it "imparts greater reality to technology development by making technology a variable instead of a parameter" (Norman, 1980, p. 3).

In his schematic representation of some determinants of FSR&D, Norman (1980) outlined the major factors involved. He included land, capital, labor, and management which constitute the input aspect of the farming system.

Integrated Farming Systems Approach

Carandang (1980) warned that initially crop-livestock enterprise might require extra resources. Among the resources required are physical, educational, and socioeconomic resources. Under physical and socioeconomic resources, Carandang (1980) included land, markets, labor, power, capital, crop and livestock. The educational resources which he called production technology included livestock and breed, farming techniques and inputs, crop variety, resource management, weed, pest, and disease management, as well as crop and livestock relations (Carandang, 1980).

Maxwell (1984b) acknowledged that the key element in FSR is targeting. He regretted that neither FSR concepts nor their procedures recognized that farming systems are in constant flux. He stated that farming systems as a target is not static but on continuous move (Maxwell, 1984b). He explored the treatment of dynamic change in the literature on FSR and found it to be haphazard and unsystematic. In developing a more rigorous framework, Maxwell (1984b) discussed the practical implications. He concluded that FSR needed improvement to encompass and exploit the possibility of dynamic change (Maxwell, 1984b). He stated that the historical evolution of farming systems found in a study area has been neglected by many FSR scientists except for a few areas (Maxwell, 1984b). These few exceptions included questions on new agricultural activities and changes in consumption habits. Maxwell (1984b) mentioned that the awareness of the importance of dynamic change is not reflected in the practical guidelines for farming systems researchers. He gave a simple model of a farming system as influenced by the determinants (Figure 2).

The major components listed were physical, biological, and

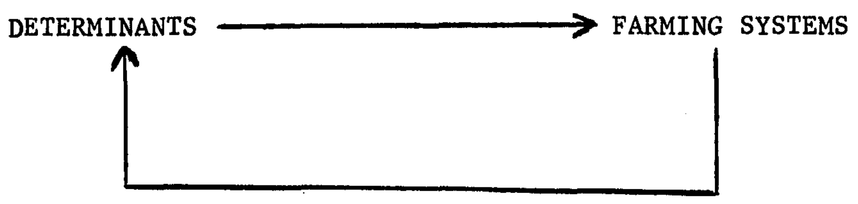

Figure 2. A simple model of a farming system as influenced by determinants (from Maxwell, 1984b)

socioeconomic determinants. The physical determinants were climate, topography, soils, and physical infrastructures. The biological determinants included the crop alternatives, livestock alternatives, weeds, pests and diseases.

The socioeconomic determinants included: (1) exogenous determinants which are comprised of population, tenure, off-farm opportunities, social infrastructure, credit, markets, prices, technology, input supply, extension, and saving opportunities; and (2) endogenous determinants consisting of family composition, health and nutrition status, education, food preference, risk aversions, attitudes, goals, etc. (Maxwell, 1984b). He emphasized that human intervention, especially through research, may affect the range of crop and livestock alternatives (Maxwell, 1984b).

Weber and Hoskins (1984) acknowledged that FSR&D is relatively new and addresses farm level problems by focusing on improving crop and livestock production. It also addresses such issues as sustainability and conservation of available land, water, and other natural resources. They stated that the FSR&D approach has two distinct advantages:

1. Technicians and experts solicit local participation in some phases and aspects of decision making. All members of the production unit are considered. Exchanging ideas with men and women farmers is an obvious improvement over expatriates and/or home country agents giving residents only perceived ideas of local problems and how to resolve them.

2. The complete FSR&D package includes an area analysis of composite needs and constraints before planning specific activities. This integrated view can result in a more balanced program and in more rational use of both local and introduced resources (Weber and Hoskins, 1984, p. 3).

In their conclusion, they emphasized that FSR&D recognizes the inseparable interaction between technical, economic, social and cultural realities that determine activities of local farm or livestock managers. FSR&D is based on holistic approach through analyzing existing situation and constraints as directed by inputs from farmers.

The role of interdisciplinary team in FSR&D

The involvement of interdisciplinary farming systems research team was to ensure for the identification and development of improved agricultural strategies which address issues about constraints faced by farmers. As the FSR process matures, it encompasses the whole range of agricultural commodities (Jones and Wallace, 1986). The authors acknowledged that the most significant characteristic of different farming systems research approaches is their ability to take biological experimentation to farmers' fields early in the research process and at the same time build farmers' feedback into evaluation at various stages. They emphasized that although university scientists can afford to specialize in crop or animal production, the farmer must manage all the components of his/her farm. They agreed that the final outcome of alternatives to the farming system and the corresponding interactions throughout the farm can only be known empirically. The complexity associated with farming system created the recognition of FSR approach as an interdisciplinary concern. The FSR approach avoids the disciplinary bias which may result in overlooking factors of importance that overlap the boundaries of disciplines (Jones and Wallace, 1986). Speaking on the importance of interdisciplinary approach to FSR, Boynton (1983) concluded that FSR recognizes "the interdisciplinary nature of FSR focused on small farmers and the need for its consideration in planning, execution, evaluation, and extension activities" (Boynton, 1983, p. 262). McDowell and Hildebrand (1980) reported that the shifting emphasis in the crop-system work by agronomists brought economists and anthropologists into the field to complement the work undertaken by agronomists. McDowell and Hildebrand (1980) encouraged the involvement of interdisciplinary teams in farming systems research. They indicated that when working in multidisciplinary teams:

> Scientists (agronomists, anthropologists, and economists) were able to obtain a fuller understanding of how the systems fitted together in determining conditions of the small farmer (McDowell and Hildebrand, 1980, p. 5).

They also stated that the involvement of animal scientists in farming systems research was recognized as scientists in different disciplines began to consider wider implications of work on crop systems. At this point, it became critical to recognize the animal side of farming systems (McDowell and Hildebrand, 1980). Following this advent, integrated crop and animal production have been acknowledged by donor agencies. A panel of farming systems researchers at Bellagio Conference in 1978, recognized the importance of animals as an integral and essential component of small-farm systems (McDowell and Hildebrand, 1980, p. 63). The panel recommended that awareness be created about the importance of integrated crop and livestock enterprises among training institutions and government agencies. In its conclusion, the panel agreed among other things that:

> . . . an integrated, multidisciplinary team approach is the most logical and effective method of helping the small farmers adjust to the ever-changing conditions found in the modern world. (McDowell and Hildebrand, 1980, p. 64).

Recognizing the importance of interdisciplinary approach to FSR&D. The United States Agency for International Development (USAID) Policy Paper on Nutrition (Axinn, 1982) stressed the need for involving expertise of many specializations to focus on the problem of alleviating undernutrition. Disciplines identified as front-liners include agronomy, food science and nutrition. However, Axinn (1982) added other disciplines such as sociology, economics, anthropology, and basic biological sciences (Axinn, 1982). Pursuing this issue further, Axinn stated:

> . . . the problem of family farming systems are not particular to nutrition, agronomy, or livestock genetics. They are problems which exist across the discipline walls we have built in academia. They require, yes demand, an integrated approach by highly trained scientists of many specializations (Axinn, 1982, p. 7).

Axinn (1982) re-echoed the suggestion earlier made in the 1981 publication of the Food and Agricultural Organization (FAO) of the United Nations called "The Peasants' Charter" which was based on the Declaration of Principles and Programme of Action of the World Conference on Agrarian Reform and Rural Development. Among the objectives raised were:

1. Review existing priorities in research, extension, and training in relation to rural development . . . and improvement of location-specific technology suitable for use by small producers and cooperatives.

2. Coordinate and integrate economic and technological research with related social science research on an interdisciplinary basis, particularly on the socioeconomic implications of technological change (Axinn, 1982, p. 8).

The establishment of the Iowa State University Farming Systems Project at the Allee Research Center manned by a team of university professionals and staff from different disciplines clearly manifested the importance of interdisciplinary approach to FSR. This systems project was designed to provide information on three different production systems by utilizing a total of five systems rotation combinations (Annual Progress Reports, 1987). The research team aimed at conducting research which helps Iowa agriculture meet tomorrow's challenges. The team's major objectives are:

1. to provide a cost and returns analysis of the three alternative systems;
2. to determine the labor required for each system;
3. to assess the relative risk of each system with respect to labor use and days suitable for field work;
4. to quantify the alternative energy consumption, both direct and indirect, by each system (Annual Progress Reports, 1987, p. 5).

<u>Theoretical and global implications of FSR</u>

Theoretically, FSR brought about the recognition and validation of the technical viability of traditional agricultural systems. The contribution is associated with:

1. the diversity of viable agriculture strategies on both a worldwide and a regional level;
2. the functional integration of social and biological aspects of agricultural production;
3. the persistence of small farm agriculture in its generally universal role of provisioning entire societies using traditional and scientifically unstudied techniques (Jones and Wallace, 1986, p. 11).

The 1986/1987 Annual Report of Consultative Group on International Agricultural Research (CGIAR) stated that:

> Higher agricultural productivity on a stable and sustainable basis depends on identifying crops, livestock, and systems of production that are adapted to their environments--whether those environments are well or poorly endowed with resources (CGIAR 1986-1987 Annual Report, Washington, D.C., p. 16).

Norman (1980) outlined certain ingredients to be considered in carrying out any farming systems research. Four out of the seven listed ingredients fall within the scope of this study. These include:

1. Four successive research stages--descriptive (diagnostic), design, testing and extension, the descriptive stage identifies the constraints and flexibility in the current farming systems. Based on the interviews with the farmers, the information is used to design, test, and extend programs for improving the farming system;
2. The farm household is central to the research process. . . . Moreover, the farmers' involvement in the research process increases the possibility that improved system will address farm level problems;
3. A multidisciplinary team required to understand the interaction of the technical and the human elements;
4. Recognition of the locational specificity or heterogeneity of the technical, exogenous, and endogenous factors (Norman, 1980, p. 6).

Norman (1980) stressed the need for developing improved technologies appropriate to homogenous subgroups. This, he said, is central to the FSR&D approach. Subgrouping, he stated, should initially be done in terms of differences in technical elements and later in terms of differences in human elements. The justification was to maximize the variance between farm systems in the subgroups and minimize the variance within subgroups. He called on FSR&D scientists to recognize the FSR process as "dynamic and interactive and emphasize linkages between the farmer and the research worker" (Norman, 1980, p. 9).

The International Center for Agricultural Research in Dry Areas (ICARDA) accepted on-farm research as a tool for identifying technological innovations which impact the entire farming system. According to its report, preferential attention has been directed toward projects that include measures of impact on the total farming systems including animals. It was stated that most FSR projects have been on case studies and the analyses of problems laid to the institutionalization of farming systems research. ICARDA adopted farming systems research as its goal since its inception in 1977. The recent attention accorded to FSR&D internationally resulted in the publication of FSR&D journals, FSR&D newsletters, etc. Reporting on the worldwide acceptance of FSR&D, Galt (1984) narrated the outcome of the FSR team invited to review the on-farm trial efforts of the Centro Internacional de Agricultura Tropical (CIAT) in Colombia. He observed that the five-man team had no differences in their method of approach. A consensus was reached as to what constituted farming systems process. The importance of involving agronomic and social scientists in interdisciplinary teams focusing on farmer-identified problems and priorities was emphasized (Galt, 1984). The experts agreed that FSR should be institutionalized on a "case-by-case" or "country-by-country" basis.

Garrett (1982) stated that FSR has the major objective to develop and to disseminate appropriate technologies that increase agricultural productivity and improve the standard of living of smallholders. According to Garrett, FSR must be able to distinguish among different groups of smallholders, identify the specific needs of these and develop technologies which represent real problems of identified target population. The problem of identifying a contemporary target audience is being addressed by Cornell University FSR team funded by the Bean Cowpea Collaborative Research Support Program. The use of secondary data was also addressed by Garrett through which the author emphasized that secondary data provide information on the number of issues surrounding FSR&D approach on the organization of agricultural productivity, farm size categories, as well as providing information on the number of farms, area occupied, crops grown, animals raised, subsistence/market production family/wage, labor employed, mechanization and tenancy (Garrett, 1982).

The decision as to what type of data to be collected in FSR was the theme of many literatures on FSR&D (Maxwell, 1984a). He advised that data be collected on physical, biological, and socioeconomic aspects both inside and outside the farming system. According to the author, two schools of thought emerged as to the type of data and how often they should be. The first school of thought was that specific hypotheses be tested in the study and that data be collected only to make that research possible. The second school of thought argued that opportunity be provided to describe farm systems as completely as possible to allow for the observation, weighing, and measuring of everything available (Maxwell, 1984a). Because of some element of difficulties posed by either of these ideas, the author suggested towing a middle path in which minimum data are collected for overall description an analysis of the farming system. He presented the idea of having a physical description of each farm especially the climate, soil, topography, physical access and map of farm use during the year. Another approach he suggested was to collect information on socioeconomic statutes of the farm family as well as analyzing the year's developments specifically focusing on the binding constraints and on the farmers' management tools used in most FSR instruments among which were:

1. map identifying individual field, the crops and livestock in the farm, field size, etc.;
2. household composition schedule listing all household members and main activities of each;
3. farm inventory covering land, land improvements, buildings, machinery an equipment, livestock and working capital, standing crops, farming practices, tillage practices, etc.;
4. cash flow records, receipts and payments including all agricultural and nonagricultural transactions;
5. the family labor use in the peak periods;
6. diary of events containing reports on crop and livestock enterprises including observations, weeds and pest problems as well as harvest and post-harvest operations;
7. field register for input and output records including agronomic information, plant density, pests and weed population;
8. no cash transactions, government program, reciprocal labor, or payment in kind; and
9. the domestic consumption (Maxwell, 1984a).

On-farm research in FSR&D

On-farm research is being adopted by international research agencies (Horton, 1985). The International Potato Center (CIP), in collaboration with Peru's Ministry of Agriculture and the International Maize and Wheat Improvement Center (CIMMYT), carried out farm-level research in the Mantaro Valley of highland Peru from 1977 to 1980. The major objectives were to:

1. sensitize CIP and national program scientists to the value of on-farm research;
2. develop and field test procedures for on-farm research with potato; and
3. train national program personnel in the use of on-farm research techniques (Horton, 1985, p. 7).

Among the summary of the research was that informal surveys and simple on-farm trials had many advantages over formal methods. The results indicated that on-farm research is useful for identifying and solving production problems within existing systems, but not for designing an entirely new system (Horton, 1985). Horton concluded that farmers have a substantial comparative advantage over researchers and extensionists in setting input levels and blending component technologies into cropping and farming systems which meet their specific needs and are equally consistent with their resource endowment.

Another FSR on the potential of on-farm research was conducted on small farms in North Alabama. About 77 percent of the farms were classified as limited resource farms. On-farm research was conducted on three small farms in 1985 with the primary objective to increase crop production through multiple cropping or by adopting new production techniques (Bishnoi et al., 1986). Results indicated that mulched tomatoes and cabbage plants yielded 56 percent more than unmulched tomatoes and cabbage. Tomatoes yielded up to 2,00 kilograms per hectare.

A similar research on soybeans resulted in 33 percent increase in yield in 45 cm row spacing. About 32 percent yield higher than the traditionally 90 cm row spacing. The trials were repeated in 1986 on larger plots at the request of farmers (Bishnoi et al., 1986).

Educational implications of FSR&D

> How can agricultural education and training be reformed in such a way that the new generation of technicians will be able to communicate with farmers and understand their complex system (Haverkort et al., 1988, p. 7)?

This type of question and many more confront the principles and methodologies behind FSR&D. Haverkort et al. (1988) supported the 1987 Farrington and Martin stand which characterized FSR as:

> An applied problem-solving approach conducted by multidisciplinary teams with a degree of farmers' participation, where the perspectives of technology changes are assessed within a holistic framework (Haverkort et al., 1988).

They agreed that FSR identifies homogeneous groups of farmers within specific agro-climatic zones as the clients of research. Fernandez (1988) emphasized the role of education in farming systems research. However, she regretted that researchers are not trained to communicate with farmers. She reiterated that the ability of the researchers to communicate with farmers' lives in stimulating their ideas and needs as well as recognizing that farmers are capable and innovative beings. Fernandez (1988) recommended participatory action research (PAR) in which the directions of change are locally rooted. The farmer in PAR takes an active part in the definition of problems and in the design of their solutions (Fernandez, 1988).

Reorientation of the educational programs of international centers, universities, agricultural colleges, and national ministries and departments involved with agricultural development have been the concern of three workshops held in 1974, 1975, and 1979 at Bellagio, Italy (Boynton, 1983). The discussions in these three workshops were centered on the needs for training of three categories of professional personnel which included:

a) Existing staff of national programs;

b) Mid-career senior scientific personnel in charge of planning and administration of the programs; and

c) Young national and foreign professionals preparing for service in national programs.

The authors listed some of the basic educational needs of a professional personnel involved in FSR which included:

> . . . orientation to problem-solving research; sense of urgency and awareness of problems; ability to handle farming skills; ability to conduct field experiments; understanding the socioeconomic situations, . . . the special needs of resource-poor farmers; ability to adapt to life in different cultures; ability to work as part of an interdisciplinary team; ability to forge linkages with institutions responsible for technology transfer; understanding the compelling need to verify laboratory and experiment station results; ability to articulate; and insight into rural development strategies (Boynton, 1983, p. 296).

In Latin America, Africa, and Asia, there have been creative and innovative farmers and professionals working together in establishing models of parts of future participatory systems of agricultural research and development. Recent issues in farming systems research include education and government policy required to build the participatory research and development system of the future (Boynton, 1983). The need for education has been stressed as:

> Innovative agricultural scientists often complain that, when a graduate of an agricultural university comes to them, they have to begin by making the newcomer unlearn much of what he/she has learned during formal education (Boynton, 1983, p. 250).

The authors then concluded that if this costly unlearning process is to be avoided, there is a need for a major reorientation in educational program. They recommended formal education for advanced degrees (M.S., Ph.D) in national and foreign universities. However, they pointed to the disillusion that may still exist when they stated:

> . . . in the U.S., the universities face a dilemma. On the one hand, the U.S. universities recognize the serious needs of developing countries--on the other hand, their primary responsibilities, the duties for which they receive public support, are to serve their own states. Their agricultural courses are becoming narrowly specialized to serve the advanced agricultural systems of the U.S. (Boynton, 1983, p. 296).

Summarizing the dilemma, the Asian Development Bank stated:

> The western educational system, which serves as the model for most, is highly discipline-oriented. Researchers are rewarded for achievements within the narrow context of their disciplines. The result is not only lack of pragmatism in research, but also an extraordinary lack of communication among disciplines. The lack of communication and understanding is reflected in the distrust between biologists and social scientists, and even within these broad categories. . . . The lack of communication exists not only horizontally among disciplines, but also vertically among research workers, extension specialists, and farmers (Boynton, 1983, p. 297).

The authors recommended multi-objective planning for educational development on the ground that planning for improved educational programs should not be carried out in isolation from the planning of activities in other closely related fields. They called on researchers to plan using the theoretical principles concerning the potential economies of multi-objectives planning which stated:

> When the same or similar human and material resource can be used to progress toward two or more socially valued objectives, this strategy will lead to a more favorable balance of benefits over costs than can be obtained when the project is designed to pursue a single objective (Boynton, 1983, p. 302).

Cashman and Persons (1988) examined the relevant and meaningful parallels between agriculture in the United States and in the less developed countries (LDC). Their study involved a sample of 30 students out of 160 from LDC who enrolled in the College of Agriculture at the University of Minnesota. The students were interviewed using an open-ended questionnaire.

The results indicated that 80 percent of the students agreed that most capital inputs that were used on American farms were considered scarce erratic in supply, or virtually unavailable to farmers in their own countries (Cashman and Pearson, 1988). Some students indicated that farmers in their countries practiced diversification of the farm systems to reduce risks, while small farmers maximized available resources by selecting various crop and livestock enterprises that have complementary requirements. The authors agreed with the "Report and Recommendation on Organic Farming" (Kramer, 1984), which concluded that the regenerative nature of organic farming in the U.S., including the objectives, practices, problems and solutions encountered on organic farms, were similar to low input farming systems observed in the LDCs. They called on land-grant colleges to take advantage of internship programs developed by the International Federation of Organic Agriculture Movements (IFOAM) to administer practical and appropriate field experience for students from LDCs.

Farming systems research and development (FSR&D), as a tool for identifying agricultural production constraints, has been widely used in most developed countries of the world. In most developed countries, farming systems studies were based on information obtained from census data or other farm program data. In France, a study was conducted on the situation and the problems of part-time farming. The study was based on the information gathered from the 1963 and 1967 surveys on agriculture covering 10 to 20 percent of all farms as well as the 1970 General Agriculture Census which covered all the farms.

The findings indicated that out of 520,000 farm families, over 90 percent had off-farm work and 40 percent were women. An increase of off-farm work among women was observed during the period 1963 and 1970. At least one member out of every six full-time farmers worked elsewhere. It was also observed that a third of the part-time farmers were low-grade blue collar workers in their off-farm jobs. The results indicated that the running of the farm was affected by the constraints of the off-farm job even though the financial situation of two-job farmers was greatly improved.

A similar study in Canada indicated that part-time farmers in Canada appeared in many respects to be similar to the part-time farmers in the United States.

He is younger than the average farmer, having frequently taken

> off-farm employment to provide additional family income while becoming established in farming or when setting up house and rearing or educating a family (OECD, Agricultural Policy Report, 1978, cited in Kramer, 1984, p. 17).

Swisher et al. (1984) described the FSR conducted in U.S. where the holistic approach to farming systems methodology was a tool for integrating both livestock and crop components into a unified research and extension program. They indicated that this approach was employed in the North Florida Farming Systems Research and Extension Project to identify specific problems within farming systems, develop alternative solutions to those problems, and test those solutions done under farm conditions (Swisher et al., 1984). They acknowledged that full integration of a livestock component into farming systems research remains a problem. Among the problems listed was the complexity of livestock systems as well as the diversity of objectives ad goals that producers may have for their livestock enterprises (Swisher et al., 1984).

The authors reported on the use of FSR methodology in North Florida where two counties (Suwanee and Columbia) served as the project site because of the large number of small farms existing in these areas. About 66 farm families were interviewed at the beginning of the project which helped to classify the farms into three major characteristics: length of time in the area, race, and type of production system. The type of production system was later grouped into three: crop-centered, livestock-centered, and mixed. It was observed that swine and/or cattle were the major components in the mixed and livestock-centered systems.

The result from the 1981 survey indicated that 58 percent of all farmers involved in the study raised hogs, while 76 percent planted corn. Out of 66 farmers interviewed, 55 percent of them used the corn they produced on their farm as animal feed, while 33 percent sold their grain (Swisher et al., 1984). A similar survey in 1983 indicated that 90 percent of all farmers maintaining corn enterprise planned to use the grain as animal feed. Based on the outcome of this study, Swisher and others concluded that farming systems methodology creates an opportunity for integrating livestock and cropping systems in a unified research and extension program. They stated that in North Florida, livestock have been integrated into the Farming Systems Research and Extension Program. They emphasized that farmers have many goals and objectives for their livestock enterprises and that:

> Both in North Florida and in developing nations. . . cattle may represent easily assessible capital (with clearly defined goals and objectives of producers, bearing in mind that) maximization of return from the livestock component alone may not be compatible with the grower's objectives if doing so requires making critical sacrifices in his other enterprises (Swisher et al., 1984, p. 261).

The representatives of ten IARCs met at ICRISAT in February 1986 and accepted FSR as an approach to agricultural research. They outlined the characteristics of FSR as follows:

1. Problem solving research which explicitly recognizes the farmer and other agents in the food system as the primary clients of agricultural research systems.

2. Research which recognizes interactions between different subsystems in the farming system and which may often require a multi-commodity approach.

3. Research with an interdisciplinary approach that requires

> close collaboration among technical scientists (physical and biological) and social scientists (Byerlee, 1986, p. 4).

They argued that FSR approach aims to improve the efficiency and relevance of agricultural research systems in terms of small farming households and at the same time preserving the research base. They reminded researchers that FSR approach is best incorporated through complementary on-farm and on-station research with farmers playing a vital role in technology design and development. They reiterated that in farming systems approach, on-farm research should be conducted with farmer participation in order to understand existing FS, identify problems and research opportunities, test appropriate solutions and monitor acceptance of improved technologies (Byerlee, 1986, p. 4).

FSR&D Recommendation Domain

The question of "For whom is the research being carried out?" led to the recognition of recommendation domain (RD) as a tool in farming systems research. It was simply defined as "a group of roughly homogenous farmers with similar circumstances for whom we can make more or less the same recommendation" (Tripp, 1986, p. 1). This term was introduced by Perriu and others in 1976 and has since been widely used in farming systems research (Tripp, 1986). It helps researchers to think about a key element of applied research. Tripp (1986) indicated that recommendation domains are one of the efficient ways of grouping farmers for an applied research program and forces researchers to ask continuously, "For whom is the research being done?" He outlined the dynamic nature of research process which included:

1. analysis of farmers' circumstances and practices;
2. an identification of priority problems;
3. a selection and testing of possible solutions; and
4. the development of recommendations; i.e., the information that farmers can use (Tripp, 1986).

Tripp (1986) emphasized that identification of recommendation domain is necessary to enable researchers to think about each step in the research process. He urged FSR researchers to determine RD by practice and problems and ultimately by solutions which generally are determined by farmers' circumstances. He called on researchers to remember that "the concept of recommendation domain is a research tool, not a policy instrument" (Tripp, 1986, p. 3). He later concluded that if the value of RD is to improve research process, researchers should be able to provide answers to the following:

a) What are the principal circumstances that distinguish groups of farmers?
b) What are the principal production problems, and who are the farmers that are affected?
c) Are all these farmers likely to benefit from the same solution?
d) What types of fields and farmers should be sought for on-farm experiments to represent farmers identified in (c) and to test possible ways of further subdividing these groups?
e) Are experimental results consistent, or are these ways of distinguishing groups of experimental sites on the basis of a characteristic that an extension agent can recognize (Tripp, 1986, p. 3)?

A contract to survey Canadian organic farmers and their farming practices was signed in 1984 between Canadian Organic Growers and Environment Canada (Kramer, 1984). Eighty organic farmers, mainly full-time farmers who had been farming for many years and whose acreage ranged from 2 to 1800, were surveyed. Livestock was usually part of the production system and the major areas of study included the marketing of organic products and data collection on nutritional benefits of organic products.

The study indicated that 70 percent of farmers involved in the study had livestock of some sort being fed on organically grown feed (Kramer, 1984). Marketing of their products was found to be through commercial channels. Recommendations from this study concluded that government-sponsored research be conducted to cover many aspects of organic farming practices as well as for the certification of organic produce.

The techniques employed in this research included sending an introductory letter to 110 organic farmers across Canada. Questionnaires were mailed to farmers after the second letter informing the farmers that they would be contacted by phone. About 79 farmers were contacted by phone. The term organic farming was defined according to the 1980 USDA study team report after an extensive, nation-wide study on organic farms as:

> . . . a production system which avoids or largely excludes the use of synthetically compounded fertilizers, pesticides, growth regulations, and livestock feed additives. To the maximum extent feasible, organic farming systems rely upon crop rotations, crop residues, animal manures, off-farm organic wastes, mechanical cultivation, mineral bearing rocks, and aspects of biological pest control to maintain soil productivity and tilth, to supply plant nutrients and to control insects, weeds and other pests (Kramer, 1984, p. 6).

Their findings indicated that 90 percent of the farms were owned by farmers. This was assumed to be comparable to the USDA case studies. The percentage of experienced farmers in the study was the same as that of USDA's study, with 31 percent having farmed for more than 20 years. About 55 percent indicated using organic methods, and 25 percent indicated having been using conventional methods. The USDA survey indicated that most of the farmers interviewed had previous experience in chemical-intensive farming (Kramer, 1984).

A similar study by the United States Department of Agriculture (USDA) in 1977 on the social characteristics of organic farming in the American Midwest indicated that five-sixths of the respondents had converted from conventional to organic farming. Similarly, a 1981 survey of organic farmers in Iowa, Nebraska, Minnesota, Illinois and Missouri indicated that three-fourths had farmed with chemicals before switching to organic method (Kramer, 1984).

The characterization of farm types indicated a diversity of production with over two-thirds of the farmers keeping livestock as well as growing a combination of grain. Smaller farms were found to be more diverse in livestock than the larger ones. The livestock on the farms were pigs, goats, sheep, and rabbits which represented a mixed crop/livestock farms. The livestock provided sources for farm manures for plant nutrients and soil conditioners (Kramer, 1984).

In Boone, Iowa, the major crusade on organic farming started in 1985 at the Dick and Sharon Thompson farm, where over 500 people, mostly farmers from nine states, converged to learn about organic farming (DeVault, 1985). According to the report, the crop/livestock farm consistently produces yields between 120-145 bushels of corn per acre and 40-45 bushels per acre of beans, for about $90 less per acre (DeVault, 1985).

The role of extension workers in farming systems research is still being debated (Youmans, 1986). Youmans (1986) noted that some research involved extension personnel in the on-going dynamics of FSR, while some assumed the extension workers would join when the results are released by researchers. He stressed the need for researchers to recognize the potential of extension service in FSR arena. He reported that Washington State University, working in Lesotho, anticipated the maximization of FSR potential by taking two early steps:

> 1. They integrated the expatriate on-farm research effort fully into the on-going activities of the National Research Division; and
>
> 2. Developed an extension unit within the same division to liaise with other Ministry divisions . . . and address the critical question of farmer organization (Youmans, 1986, p. 5).

In the Lesotho FSR, extension was charged with the responsibility of conducting programs in farmer education and to oversee the dissemination of research results through publications and the radio network (Youmans, 1986).

Swisher (1986) stressed the need for extension in FSR and condemned the paradigm that educating agents about new technologies be viewed as a new step in the process of information dissemination. He noted that energy and money were being wasted in the agents' education on subjects that were not useful or interesting. Swisher (1986) concluded that FSR and Extension (FSR&E) approaches be adopted to bridge the gap and intimately involve agents with the researcher and with the research process.

Some research on farming systems have also been carried out by the

Rodale Research Center (RRC) under the umbrella of organic farming research (Harwood, 1982b). The RRC conceptualized the framework of their research on the assumption that in a resource-limited world with an increasingly fragile environment, we no longer are able to structure and dominate natural systems. The dominance model for agricultural production is becoming increasingly impractical (Harwood, 1982b). The RRC stated that the ultimate goal for their research was the attainment of a generative agriculture which they defined as "one that transcends the organic concept and model; an agriculture that adds to our production base while providing food and fiber for humankind" (Harwood, 1982b, p. 4). The thrust areas of research in RRC include the development of new methods for the enhancement of natural systems in the organic production of crops and animals. It also includes the documentation of the effectiveness or lack of existing organic methods as well as developing specific technologies which are needed to promote efficient production systems (Harwood, 1982b).

Among the research conducted in Rodale Research Center was the New Farm Magazine Readerships. This study was carried out in collaboration with the United States Department of Agriculture (USDA) in 1979. A detailed questionnaire designed to focus primarily on the descriptive information needed to complete the USDA report was sent to 60,000 readers of the magazine, "The New Farm" (Harwood, 1982b). The outcome of the study provided an insight into the nature and content of organic farming in the U.S., which in 1981 triggered a seven-state study of organic farmers.

A list of 5,000 names was gathered from the states of California, Oregon, Washington, Idaho, Kansas, Pennsylvania, and Maine, including names from the Maine's Organic Farming and Gardening Association, the Kansas Organic Growers, TILTH organizations, the Amity Foundation and other organizations having contact with organic farmers. With the cooperation of states' cooperative extension services, questionnaires were mailed to farmers in the selected counties of the states involved. A more detailed questionnaire was mailed to 500 farmers out of which twelve farmers were selected for detailed study. These farmers were visited on a monthly basis with the major objective to look at the enterprise combinations, acreages, and the extent of farming operation for many different kinds of organic farms. The results of the study indicated a much broader range of enterprise types in organic operations than anticipated. Extreme large scale cash grain operations were also identified. The results contradicted the original views that organic operations must be highly integrated (Harwood, 1982b).

Harwood (1982b) reported on the increasing interest in organic agriculture research by American universities as well as government and private research centers. One of the completed surveys on FSR was the dairy and beef producers' study conducted by the University of Missouri and Washington State University in the midwestern corn belt. The results indicated that although organic farms had slightly lower yields, they used less than half the energy per unit of produce. They had lower production costs and had equivalent net returns similar to conventional farms. Similar findings were observed in a survey of Wisconsin farms.

The author indicated that similar surveys were under way among many U.S. universities: the University of Nebraska on organic farms in eastern Nebraska, and Michigan State University at the central Michigan mixed farms. Similar studies are going on at Pennsylvania State University, as well as in the University of North Carolina. The University of Nebraska, in collaboration with the University of Maine, is studying long-term, on-station research trials by comparing organic and conventional management systems (Harwood, 1983). Reporting on the outcome of research on organic practices being conducted by Rodale Research Center, Harwood (1983) stated that the yield average was within 5 percent of industrial agriculture, while the energy cost per unit of produce was about half that of industrial agriculture. The production cost was lower by 35 percent, while the net return per hectare was the same or higher for most of the 30,000 to 40,000 organic farms.

Dlouhy (1983), in the "Philosophy behind Alternative Forms of Agriculture," concluded that:

> We are consciously unconscious that the development on earth has a clear course toward an ecological disaster. The fundamental reason is found in the complex of ideas upon which European (Western) culture is based, primarily on the efforts to exploit nature through technical aids. It is ideas which are decisive in regulating the means by which technology is used. Thus, before starting to discuss methodological problems such as scale, diversity, production and labor intensity, etc., efforts should be made to elucidate problems concerning the overall objectives for production within an agricultural system (Dlouhy, 1983, p. 53).

Dobbs and others (1988) reported on the factors influencing the economic potential for alternative farming systems--a case analysis in South Dakota. They acknowledged that relatively few studies had systematically documented the costs and returns of alternative farming systems. They also noted that in the U.S., especially in the northern plains, alternative farming systems were labeled by such terms as "organic, low input, reduced input, sustainable, and regenerative" agriculture, which in recent years drew the attention of agronomists, agricultural economists, and policy makers (Dobbs et al., 1988). The big question among farmers was: "What are the costs and returns of alternative farming systems, relative to more conventional systems?" (Dobbs et al., 1988, p. 26).

Two farming systems studies (FSS) were conducted with the objective to determine the factors that influence economic potential for alternative farming systems. The first farming systems study (FSS1) consisted of an alternative rotation of oats, alfalfa, soybeans and corn compared with the conventional and ridge-tilled rotation system of corn, soybeans, and spring wheat. The second farming systems study (FSS2) consisted of three systems with emphasis on small grains comparisons.

The results of the analyses of FSS1 and FSS2 indicated that alternative farming systems could be competitive with more conventional systems in certain situations. The alternative system was marked with lower direct costs and in some areas provided approximately the same net returns as the comparable conventional and minimum till systems (Dobbs et al., 1988). Dobbs and others concluded that the on-going agronomic investigation on tillage practices, fertility, and yield levels is critical to the understanding of alternative farming systems and its economic feasibility. They highlighted the fact that the multiple roles of livestock in alternative farming systems, economic feasibility, and the availability of animal manure for soil fertility deserved greater attention.

Bender (1988), in "Does Organic Farming Require Too Much Livestock?", raised and tried to mollify certain opinions about FSR. He raised questions about the future of organic farming and related sustaining agricultural systems. In simple terms, he called organic farming the "integration of livestock husbandry with feed production" (Bender, 1988).

He argued that a livestock herd was necessary on an organic farm in the number required to meet soil conservation requirements, to reduce fertilizer needs and enhance soil structure by recycling nutrients and organic matter, to provide financial diversity and stability, and to permit reduction or elimination of pesticide use. He gave an example of 320 acres of land with 30 cows and one bull, 27 calves, and 26 yearlings per year and asked if it would meet the requirement of organic farming. After due analysis, he concluded that:

> . . . the too much livestock criticism of organic farming is currently without foundation. . . . The form of attack on organic farming misuses its own device of argument, ignores the highly relevant subjects of where current livestock production could be located, and fails to acknowledge that a surprisingly modest quantity of livestock can be organized to create a threshold of viable organic method (Bender, 1988, p. 40).

This review of literature illustrated the importance of farming systems research and development (FSR&D) in both developing and developed nations of the world. It revealed the guiding principles and philosophies surrounding the FSR&D approach toward identifying agricultural production constraints. The literature indicated variability in Farming Systems Research (FSR) in terms of its definition and methodology.

However, the essential characteristics of FSR were common to most FSR and were highly emphasized in the literature. Among the essential characteristics were that FSR&D is directed toward low-resource or small-scale farm operators. It is holistic in nature. The farmer or farm operator was indicated in the literature as the sole beneficiary and the center of farming systems research. The involvement of an interdisciplinary team in FSR was the hallmark of this research approach.

The literature review indicated a varietal methodology in FSR approach. However, researchers warned that each method must be developed to adapt to a specific ecosystem. There was no standardized method approach mapped out for all farming systems research.

The literature traced the historical development of U.S. agriculture and the establishment of the existing farming system in Iowa. It also explored the impact of different legislature in the shaping of the American agricultural system.

The role of education in FSR approach was reviewed in the literature. The literature indicated lapses in the educational needs and implications of FSR&D. This deficiency in educational implications justifies the need for this study. The origin of FSR was linked to the efforts of international agricultural organizations and their funding agencies. With few exceptions, most FSR was conducted in the developing countries. The Consultative Group on International Agricultural Research

(CGIAR) spearheaded the development of FSR among international research agencies. However, the general consensus among farming systems researchers included that FSR be recognized as being supplementary to conventional research. The distinct features of FSR were compared to those of conventional research. The literature indicated that one of the distinct features of conventional research is that it tends to ignore the human element as opposed to FSR approach which encourages participation of the entire family. The literature also stressed that FSR takes cognizance of production input factors as well as the market, labor, social and economic aspects that constitute the components of any farming systems.

The spread of FSR approach among international research bodies notwithstanding, critiques did warn against the shortcomings of using FSR as a sole determinant of solutions to agricultural constraints. Prominent among the bottlenecks were the constraints posed by the international funding agencies who have mapped out goals and objectives. Generally, this review of literature revealed the great potentials yet unleashed in the application of FSR&D approach to identify production problems in agriculture.

METHODS AND PROCEDURES

This chapter has been organized under six major headings: Methodologies in Farming Systems Research; Population and Sample Selection; Development of Instrument; Reliability Test; Data Collection; Data Analysis; and Factor Analysis.

For the purpose of this study, farming systems research and development (FSR&D) was viewed as a resultant product of a complex interaction of many interdependent components with the farmer at the center of the interaction. Hildebrand (1986) indicated that:

> A specific farming system arises from the decision taken by a small farmer or farming family with respect to allocating different qualities of land, labor, capital, and management to crop, livestock, and off-farm enterprises in a manner which, given the knowledge the household possesses, maximize the attainment of the family goal(s) (Hildebrand, 1986, p. 32).

The following assumptions provided the basis for this study:

1. Crop/livestock enterprise will ensure labor distribution all year round for farm operators;
2. Crop/livestock enterprise guarantees steady and increased income for the household;
3. Operational efficiency of small farms may increase through better management of limited resources; and
4. Agricultural products from crop and livestock integration complement the upkeep of the enterprise.

Different methodologies have emerged among international research institutions in the developed and developing countries. Secondary data were employed in most farming systems research (Garrett, 1982; Winkelmann and Moscardi, 1982). Garrett (1982) emphasized that secondary data provide information on issues surrounding the farming systems research and development (FSR&D) approach. Maxwell (1984a) suggested that data collection should include physical, biological, and socioeconomic elements inside and outside the farming system.

Some other methods used in collecting information in FSR&D were to test specific hypotheses and at the same time collect enough information that would make the study possible (Maxwell, 1984a). Other researchers suggested that an opportunity be provided to describe the whole farming system. Maxwell emphasized collecting minimum data for overall description of each farm including the climate, soil, topography, physical access, and map of farm use during the year (Maxwell, 1984a). Other suggestions included collecting information on socioeconomic status of the farm family as well as analyzing the year's developments.

On-farm trials have been employed to obtain data on existing farming systems as well as conducting informal, but organized, discussion with farmers (Jones and Wallace, 1986; Winkelmann and Moscardi, 1982). They encouraged researchers to identify farmers' circumstances and avoid using secondary data to create impressions which prevent orienting research on improved technology.

Another method employed in FSR was the use of census data. The use of census data had been extensive in temperate farming systems (Organization for Economic Cooperation and Development (OECD), Agricultural Policy Report, 1978, cited in Kramer, 1984). The use of these methodologies in FSR still calls for questions as to whether the selected farmers were typical of farmers with limited resources (Henry, 1987), and whether participating farmers did alter the methods of establishing research priorities. With these questions unanswered, Henry stressed the outcome of research conducted by Chambers and Jiggins which concluded that:

> Traditional agricultural research, however impressive its results when directed at better-off farmers, has not been effective in serving resource-poor farmers (Henry, 1987, p. 15).

Population and Sample Selection

The population for the study included farm operators in Story and Boone Counties of Iowa. Selection of these counties was based on their geographical location, their agricultural resource base, and their proximity to Iowa State University where the multi-disciplinary team will be selected for further research on FSR. The list of farm operators for the study was obtained from Agricultural Stabilization Service in both counties. A total of 1878 farm operators was identified--977 and 901 from Story and Boone Counties, respectively. About 195 (20 percent) and 183 (20 percent) farmers from Story and Boone Counties, respectively, were randomly selected to participate in this study. A stratified sample of identified farm operators resulted in 158 and 150 (81.03 percent) farm operators from Story and Boone Counties, respectively (Table 1). This sampling process ensured proportionality in the number of participants involved in the study. Farm operators were then located using Farm and Home Directory and Plat Boone County, Iowa, 1987; Farm and Home Directory

<u>and Plat, Story County 1988</u>; and <u>Phone Directory, Ames Area Wide, 1988</u> as well as the <u>White and Yellow Pages U.S. West Direct, Ames, Story County</u> area. Out of 195 and 183 farm operators, 37 and 33 farm operators from Story and Boone Counties, respectively, were used as substitutes for participants who chose not to participate in the study and as a substitute for incomplete instruments and for instruments lost in transit. Table 1 reveals the number of questionnaires received and the response rate. All substitutes were used in the study.

Table 1. Population, sample and response rate of questionnaires

County	Population sample	Study sample (20%)	Participating sample (81.03%)	Substitute sample (18.97%)	Number returned	Response rate (%)
Story	977	195	158	37	113	57.79
Boone	901	183	150	33	110	60.01
Total	1878	378	308	70	223	59.00

Development of Instrument

The instrument for the study was developed to reflect the objectives of the study after a comprehensive literature search on FSR methodologies. The instrument was divided into four parts; namely:

1. Part One (two sections--A and B). Section A covered FSR&D, while section B dealt with some crops and livestock in the existing farming system (Appendix A).
2. Part Two (two sections--A and B). Section A identified some of

the constraints militating against agricultural production in the two counties. Respondents were asked to respond, on a scale of 1-5, to the degree of constraints posed by each of the mentioned variables. Section B consisted of agricultural subject matter and programs, and participants were asked to respond according to the importance of the subject matter now and in the future (Appendix A).

3. Part Three (three sections--A, B, and C). Section A contained information sources, and farm operators were asked to identify and record the level of importance using the scale provided. The same instruction was given for items in sections B and C (Appendix A).

4. Part Four was used to collect demographic information concerning farm operators involved in the study (Appendix A). In order to minimize the cost which might be incurred by nonrespondents, Business Reply Mail of Iowa State University was printed at the back of the instrument. A cover letter explaining the purpose and objectives of the study was printed on the front page of the instrument (Appendix A).

The validity of the instrument was checked by members of the university staff in both the Departments of Agricultural Education and Anthropology at Iowa State University. The instrument was reviewed and submitted to the Iowa State Committee on the Use of Human Subjects in Research on December 12, 1988. The instrument was modified as directed by the committee and was approved on December 16, 1988, and was printed.

Reliability Test

The Cronbach's Alpha sub-program reliability procedure was used to compute the reliability of the item responses according to sections. Items in Part One (section A) of the instrument yielded a reliability coefficient alpha of 0.77, while items in Part Two (sections A and B) gave a reliability coefficient alpha of 0.74 and 0.95, respectively. Responses in Part Three (sections A, B, and C) yielded reliability coefficients of alpha of 0.88, 0.85, and 0.65, respectively. The reliability coefficient values indicated a reasonable consistency of the instrument used in the study.

Data Collection

Printed questionnaires with the cover letter on the front page and a postage-paid business reply envelope were mailed to 378 farm operators in both Story and Boone Counties on January 21, 1989. A follow-up letter with the same questionnaire attached was posted to non-returnees on February 2, 1989. The letter emphasized the urgency for farm operators to complete and return the instruments (Appendix B). A total of 223 questionnaires were returned, representing an average of 59.00 percent of the entire sample (Table 1). Only 184 were found sufficiently viable to be used in the study. Those questionnaires returned included five which were destroyed by the office machines; ten people called and demanded that their name be removed from the study; 24 questionnaires (17 from Story County and 7 from Boone County) were returned incomplete or partially completed. Responses from the 184 usable questionnaires were coded onto four IBM cards for analysis.

Data Analysis

The data for the study were analyzed using the Statistical Package for the Social Sciences (SPSSx). The statistical procedures involved were both descriptive (frequency, mean, and standard deviation), and analytical (one-way analysis of variance, factor analysis, and reliability test). Frequency counts, percentages, means, and standard variation of all items were computed.

Factor Analysis

Correlation matrices were prepared for items in Parts One, Two and Three using Pearson product-moment correlation coefficient procedures. To proceed with factor analysis, the item responses were tested for appropriateness using the Bartlett's Test of Sphericity. This test helped to determine whether the correlation matrix was an identity matrix. The results of the test and significance according to each section are shown in Table 2.

Table 2. Results of the Bartlett's Test of Sphericity and Kaiser-Meyer-Olkin (KMO) Test of Sampling Adequacy

	Bartlett Test	KMO Test
Part One	(Sect. A) = 1590.95 significance = 0.00	0.78
Part Two	(Sect. A) = 609.22 significance = 0.00	0.76
	(Sect. B) = 6783.71 significance = 0.00	0.79
Part Three	(Sect. A) = 1149.79 significance = 0.00	0.84
	(Sect. B) = 801.15 significance = 0.00	0.81
	(Sect. C) = 449.88 significance = 0.00	0.75

The results indicated that all six sections of the instrument passed the test which allowed for factor analysis of the items.

The Kaiser-Meyer-Olkin (KMO) test was employed to measure the sampling adequacy. The test compared the magnitude of the observed correlation coefficients to the magnitudes of the partial correlation. The results from the KMO test are shown in Table 2.

The procedure for factor analysis was initiated at the completion of these tests. Item missing values were replaced by the item means. Factor analysis was conducted for each section in the instrument which resulted in the grouping of items according to factor loadings. A common name was assigned to each factor after examining them for rational consistency. Items which did not contribute to the general theme of factors were eliminated. The Varimax Rotation procedure was employed to maintain high utility with factors that were orthogonally rotated (Cooley and Lohnes, 1962). An r-value of 0.50 or more was selected in each factor loading to maintain Comrey's factorial validity test in which absolute values were employed. An index of internal reliability was calculated for each factor loading using the formula:

$$\frac{n\bar{r}jj}{1 + (n-1)\ \bar{r}jj'}$$

where n refers to the number of items in the cluster and $\bar{r}jj$ refers to the average intercorrelation among the items (Cranny, 1967, p. 15).

One-way analysis of variance was employed to compute differences among farm operators in terms of age, number of years in operation, education status, and annual income as independent variables for each of the factors identified. Independent variables were recoded before using them to run one-way on each factor. A post-hoc analysis, using the Scheffé multiple range test, was carried out to determine differences among groups for F-values significant beyond the assigned level (alpha = 0.05).

FINDINGS

The purpose of this study was to determine the relevant educational program needs of the existing farming systems in Iowa, identify ways of improving them, and provide information as to the farmers' perceptions about conducting farming systems research on integrated crop and livestock enterprises. The major research objectives were:

(1) to determine farmers' perceptions about ways to improve existing farming systems and how best the livestock enterprise could be incorporated into the existing system;

(2) to identify farming systems educational program areas, sources of farming information, and the extent of cooperation between farmers and public agencies;

(3) to identify the deficiencies and constraints of existing farming systems as perceived by farmers with implications for agricultural education.

This chapter is divided into eight areas: (1) Reliability of instrument; (2) Demographic information--type of farming operation including the types of crops and livestock on the farms; (3) Farmers' perceptions about integrated farming systems research and development; (4) Farming constraints; (5) Information sources; (6) Farming systems educational programs; (7) Extent of cooperation between farmers and public agencies; and (8) Major findings.

Reliability of Instrument

The instrument used for this study was tested for reliability. Table 3 reveals the results of the reliability tests according to instrument section, the number of cases, the number of items, and the alpha levels.

Table 3. The reliability test of the instrument

Description	Number of cases	Number of items	Alpha level
Farming systems research	112	30	.7741
Farming constraints	112	12	.7417
Present agricultural program	112	21	.9092
Future agricultural program	112	21	.9121
Information sources	112	15	.8775
Public and private agencies	112	12	.8491
Market outlet	112	10	.6468

The Cronbach alpha coefficients ranged from .7417 to .9121 except for the use of marketing outlets which had a coefficient of .6468. Present and future use of agricultural programs had reliability coefficients of .9092 and .9121, respectively. Farming systems research and development (FSR&D) items had a reliability coefficient of .7741 as opposed to agricultural constraint with a coefficient of .7417. Information sources and the extent of cooperation between the farmers and other parastatals (public and private agencies) had reliability coefficients of .8775 and .8491, respectively. The results of the reliability test indicated a uniform reaction among respondents in each section of the instrument. These high alpha scores indicated that appropriate statistical tests could be employed to achieve the desired objectives of this study. However, the lower alpha in the use of market outlet should be left for individual interpretations.

Characteristics of Respondents

This section deals with the demographic characteristics of respondents. Table 4 contains the frequencies and percentages of farm operators in Boone and Story Counties of Iowa who were involved in the study. The 184 respondents were grouped according to gender, age, marital status, number of children, type of farm operation, years of formal education, annual income, and the number of years in operation. Data about resource allocation in the farm were also collected and tabulated, as shown in Table 4.

Out of 184 respondents, 180 (97.8 percent) were male, and 170 (92.4 percent) were married. Respondents in this study had a mean age of 52.19. Only 25 percent of the respondents were between the ages of 27-40 years, while the majority of the respondents (39.7 percent) were between the ages of 41 and 59. Over 35 percent of the respondents were between the ages of 60 and 78.

Respondents were asked to indicate the number of children in their household. About 23 percent indicated having one or two children in the house, whereas 27.7 percent (51 farmers) had three or more children in their household. The majority of farmers (48.9 percent) had no children. This supports the idea that farming operation is mainly carried out by

Table 4. Demographic characteristics of respondents

Item	Descriptors	Frequency	Percent
Gender	Male	180	97.8
	Female	4	2.2
	Total	184	100.0
Age	27-40	46	25.0
	41-59	73	39.7
	60-78	65	35.3
	Mean = 52.188		
	Total	184	100.0
Marital status	Single	14	7.6
	Married	170	92.4
	Total	184	100.0
Number of children	1-2	43	23.4
	3 or more	51	27.7
	None	90	48.9
	Total	184	100.0
Type of operation	Full-time farmer	128	69.6
	Farm owner	139	75.5
	Tenant	78	42.4
	Rent your farm	40	21.7
	Farm on contract basis	20	10.9
	Have part-time job	34	18.5
	Employ additional labor	52	28.3
	Use family labor	73	39.7
Years of formal education	8-11	20	10.9
	12 only	88	47.8
	13-27	76	41.3
	Mean = 13.049		
	Total	184	100.0
Annual income	$20,000 or less	45	24.5
	$20,001-$30,000	50	27.2
	$30,001-$40,000	30	16.3
	$40,001 or above	47	25.5
	Missing	12	6.5
	Total	184	100.0

Table 4. (Continued)

Item	Descriptors	Frequency	Percent
Number of years in operation	1-15	58	31.5
	16-29	42	22.8
	30-39	39	21.2
	40-56	42	22.8
	Missing	3	1.6
	Total	184	100.0
Resource allocation	Farm equipment	130	21.53
	Fertilizer	135	21.49
	Seed	135	14.44
	Feed	83	25.28
	Chemicals	131	16.84
	Labor	115	14.03

couples (husband and wife) (Deseran et al., 1984).

The type of farming operation was also used to determine the characteristics of the respondents. Table 4 indicated that over 69 percent of farm operators were full-time farmers, and over 75 percent owned their farms. Only 18.5 percent of the respondents maintained part-time jobs, whereas 28.3 percent employed additional labor. Almost 40 percent of the farmers used family labor in their farming enterprise.

Farm operators were also asked to indicate their number of years of formal education ranging from 1 to 18 years. Most farmers (47.8 percent) had completed 12 years of formal education. A large percentage (41.3 percent) had completed more than 12 years of formal education. However, 10.9 percent of the respondents had had between 8 and 11 years of formal education, thereby bringing the average number of years in school to 13 years.

The income of farm operators was also considered in this study. Income was between $20,000 or less to $40,001 or more. The information in the table indicated an even distribution of income among respondents. However, a majority of farm operators fell within the income range of $20,001 and $30,000 (27.2 percent). A large number (24.5 percent) indicated having annual incomes of $20,000 or less, whereas 25.5 percent had incomes between $40,001 or above.

As regards the number of years in farming, most farmers had been in operation for 15 years or less. About 22.8 percent of the farm operators indicated having been in operation between 16-29 and 30-39 years, respectively. The overall mean number of years in operation for the respondents was 26.59 years.

Farm operators were also asked to indicate how their farm input resources were allocated in terms of farm equipment, fertilizer, seed, feed, chemicals, and labor. Only a limited number of farm operators answered this section as intended. However, the available data were used to compute the resource allocation on the farms. Resources allocated to feed topped the rest with 25.28 percent, while farm equipment and fertilizer had 21.53 and 21.49 percent, respectively. Seed and labor had the lowest resource allocation--14.44 and 14.03 percent, respectively. The greater resource allocation to feed might be attributed to livestock production on the farms.

Farming Systems Research and Development (FSR&D)

The first objective of this study is dealt with under this heading. The objective was to determine farmers' perceptions on ways to improve existing farming systems in Iowa and how best the livestock enterprise could be incorporated into the existing system. Table 5 contains the means, standard deviations, and mean rankings of items relating to farming systems. Items were rated on a scale of 1-4. The overall mean was 2.87 and standard deviation was .63. The highest mean score (3.32) and a standard deviation of 0.61 were for "farmers or farm operators having more say concerning agricultural policies which affect them," followed by "farm operators' need for agricultural systems which are efficient and sustainable" with a mean of 3.23 and a standard deviation of 0.59. "Increasing the size of farming operation to maximize profit in

Table 5. Means, standard deviations, and mean rankings for the specific items relating to farming systems research and development (FSR&D)

Item	N	Mean	Standard deviation	Mean rank among FSR&D means
Farm operators working in partnership with researchers is necessary in solving farm problems	180	2.93	0.57	18
Both conventional research and farming systems research are required to solve present farm problems	180	2.98	0.53	12
Farm operators need agricultural systems which are efficient and sustainable	181	3.23	0.59	2
The financial and social needs of farm operators have not been met by the present agricultural system in Iowa	176	2.75	0.78	23
Diversification in agriculture should be a solution toward a sustainable agricultural economy	181	2.89	0.64	19
Examining the farm operation as a whole may help to identify the major constraints of Iowa farms	181	2.94	0.51	15
Present agricultural policy is responsible for the present crisis in Iowa farms	178	2.61	0.82	27
Agricultural educators need to promote efficient, sustainable and profitable agricultural systems	180	3.11	0.54	7
Farm research conducted in farmers' own fields will facilitate decisions about new agricultural innovations	179	3.06	0.54	9

Table 5. (Continued)

Item	N	Mean	Standard deviation	Mean rank among FSR&D means
Farmers or farm operators should have more say concerning agricultural policies which affect them	180	3.32	0.61	1
Increasing the size of farming operation is necessary to maximize profit in any agricultural enterprise	181	1.95	0.74	30
Merging or combining farm operations with other producers will assure a marginal profit	178	2.04	0.63	29
Farmers who raise both crops and livestock profit more than those who raise either crops or livestock	181	2.75	0.71	22
Pushing small-scale operators out of business will hurt United States agricultural economy	181	3.14	0.81	5
The consumers will suffer the impact of eliminating small-scale farmers	181	3.10	0.82	8
Farm research conducted with farmers participating is more beneficial than ones conducted by researchers alone	181	3.16	0.62	4
Agricultural research conducted in universities and experiment stations should be tried in farmers' fields	181	3.06	0.59	10
An interdisciplinary team approach will help to identify the limiting constraints of any agricultural systems	164	2.74	0.56	24
Introducing livestock in Iowa farms will increase the net profit from agricultural production	179	2.68	0.67	26

Table 5. (Continued)

Item	N	Mean	Standard deviation	Mean rank among FSR&D means
Crop and livestock enterprises promote even distribution of labor and resources in the farm	181	2.94	0.63	16
Crop and livestock integration ensures an equitable distribution of farm income all year round	180	2.80	0.66	21
Specialization in agricultural production has limitations in terms of efficiency and sustainability	177	2.69	0.64	25
Farming should be regarded and treated as any other business in the United States	177	2.85	0.79	20
Agricultural educators should educate farm operators on subject matter relevant to their enterprises	178	2.97	0.53	13
The state and federal government should protect farmers from foreign competitors	177	2.94	0.77	17
Farmers need more marketing information to stay in business	179	2.96	0.65	14
Farm operators are capable of making useful decisions on farm issues if enough information is made available	181	3.17	0.48	3
Farmers need more subsidies and protection from lending institutions to stay in business	179	2.15	0.71	28
Livestock integration on Iowa farms provides organic manure to improve the soil conditions	179	3.12	0.58	6

Table 5. (Continued)

Item	N	Mean	Standard deviation	Mean rank among FSR&D means
The quantity of commercial fertilizer used in Iowa farms will be less if livestock is raised in the farm	184	3.00	0.67	11
Overall mean		2.87	0.63	

any agricultural enterprise" had the lowest mean rating of 1.95 and a standard deviation of 0.74, followed by "merging or combining farm operations with other producers to ensure a marginal profit," with a mean rating of 2.04 and standard deviation of 0.63. Farm research with farmers' participation was rated fourth among the items, while the ability of farm operators to make "useful decisions on farm issues if enough information is made available" ranked third with the mean of 3.17 and a standard deviation of 0.48. At this juncture, we have to point out that the ten highest ranked items were centered on research, efficient and sustainable agricultural systems, farmers' participation, decision making, on-farm trials, maintaining small-scale operators, crop/livestock integration, education, and research information.

In this section, farmers were asked to indicate the type of crops and livestock raised on their farms. Table 6 illustrates the crop/livestock on their farms and their percentages. An overwhelming majority of the farms (95.70 percent) grew corn. Over 87.5 percent of the farms grew soybeans. The production of hog and beef cattle was observed on 40.20 and 35.30 percent of the farms, respectively. The overall results from Table 6 indicated a diversified crop and livestock enterprise on most farms involved in the study. The least produced crop among respondents was wheat (1.6 percent) and sorghum (1.1 percent), and barley was not produced by any respondent. Goats had the least production percentage among livestock, followed by rabbits (2.2 percent).

Table 6. Frequency and percentage of crops and livestock produced

Crop/livestock	Number of farms	Percent
Corn	176	95.70
Oats	74	40.20
Barley	--	--
Wheat	3	1.60
Soybeans	161	87.50
Feed grain	12	6.50
Hay	99	53.80
Corn silage	13	7.10
Beans	15	8.20
Sorghum	2	1.10
Dairy cow	9	4.90
Hog	74	40.20
Beef cattle	65	35.30
Sheep	29	15.80
Goat	1	0.50
Rabbits	4	2.20

Factor Analysis on FSR&D Items

The item responses in FSR&D were further subjected to other analyses as indicated in the procedure chapter. Items were grouped according to factor loadings, and each factor was assigned a name as reflected by the component parts. Items grouped together were highly related considering their correlation coefficient and having passed the KMO and Bartlett tests. When subjected to further analysis, the 30 items emerged with six factors. Data in Table 7 summarize the results of factor analysis groupings for FSR&D items. The factor groupings included: (1) Small-Scale Agriculture; (2) Crop/Livestock Integration; (3) Problem Solving; (4) On-Farm Trial; (5) Agricultural Protection; and (6) Market Information.

Table 7. Factor loadings of groupings of farmers' responses to farming systems research and development (FSR&D) items

Factor grouping	Loading
Factor One--Small-Scale Agriculture	
The consumer will suffer the impact eliminating small-scale farmers	.797
Pushing small-scale operators out of business will hurt United States agricultural economy	.777
Farm research conducted with farmers participating is more beneficial	.636
Increasing the size of farming operation is necessary to maximize profit	-.556
Farmers or farm operators should have more say concerning agricultural policies which affect them	.509
Factor Two--Crop/Livestock Integration	
Crop and livestock enterprises promote even distribution of labor and resources on the farm	.675
Farmers who raise both crops and livestock profit more than those who raise either crops or livestock	.659
Introducing livestock in Iowa farms will increase the net profit from agricultural production	.648
Crop and livestock integration ensures an equitable distribution of farm income all year round	.630
The quantity of commercial fertilizer used in Iowa farms will be less if livestock is raised on the farm	.612
Livestock integration on Iowa farms provides organic manure to improve the soil condition	.607
Factor Three--Problem Solving	
Farm operators working in partnership with researchers is necessary in solving farm problems	.844
Both conventional research and farming systems research are required to solve present farm problems	.809
Farm operators need agricultural systems which are efficient and sustainable	.661
Factor Four--On-Farm Trials (OFT)	
Farm research conducted in farmers' own fields will facilitate decisions about new agricultural innovations	.712
Diversification in agriculture should be a solution toward a sustainable agricultural economy	.592
Agricultural research conducted in universities and experiment stations should be tried in farmers' fields	.550

Table 7. (Continued)

Factor grouping	Loading
Factor Five--Protection through Policy/subsidy	
Farmers need more subsidies and protection from lending institutions to stay in business	.694
Present agricultural policy is responsible for the present crisis in Iowa farms	.694
The financial and social needs of farm operators have not been met by the present agricultural system	.691
Factor Six--Market Information	
Farmers need more marketing information to stay in business	.744
Farm operators are capable of making useful decisions on farm issues if enough information is made available	.619

Data in Table 7 summarize the results of factor analysis for farming systems research and development (FSR&D) items. Five items were grouped together under Factor One. Two items, "The consumer will suffer the impact of eliminating small-scale farmers" and "Pushing the small-scale farmers out of business will hurt United States economy," had factor loadings of .797 and .777, respectively. Note that "Increasing the size of farming enterprise," which was ranked last among FSR&D items and had a negative factor loading of -.556. "Farm operators working in partnership with researchers" and "Both conventional and farming systems research required to solve the present farm crisis" had the highest factor loading scores of .844 and .809, respectively, in Factor Three--Problem Solving. There was an even distribution of factor loadings among the factors, but the idea of farmers having more say in agricultural policies which concern them received the lowest loading value of .509. Items in Factor Two (Crop/Livestock Integration) had fairly uniform factor loadings, indicating internal consistency among item responses and within factor means.

Analytical Results for FSR&D Factors

Tables 8, 9, 10, and 11 reveal the means, standard deviations, F-values, and F-probabilities of factors by income, number of years of formal education, the number of years in farming operation, and the age of operators. To proceed with the analysis, the independent variables were recoded to allow for equal cases among items and within factor groupings. The number of years of formal education was recoded into three groups--(1) those with 8-11 years of formal education; (2) those with 12 years of formal education; and (3) those with 13 or more years of education. Table 8 contains the group means, standard deviations, F-values, and F-probabilities of FSR&D factors according to number of years of formal education. The highest mean score of 3.14 was observed for Factor Six (Market Information) among operators with 8 to 11 years of college education. Farm operators with 12 years of formal education had the highest mean of the means of 2.96, followed by those with 8 to 11 years of formal education with 2.89. Factor Five (Agricultural Protection) had the lowest total mean score of 2.5. A significant difference among groups was observed in Factor Three (Problem Solving) beyond the 0.05 alpha level. The Scheffé test indicated significant differences between the mean scores of farmers between 8 and 11 years of college education and those with 12 years of formal education and 16 and 27 years of education.

Data in Table 9 reveal farming systems factors by year of operation. The number of years in farming operation was recoded after obtaining the initial frequencies to allow for moderate uniformity of groups. In Table 9, Factor Three (Problem Solving) had the highest mean score of 3.15 among operators with 1 to 15 years of farming experience. Factor Four (On-Farm Trial) had the highest mean of 3.15 among operators with 16 to 29 years of farming experience. Factor Five (Agricultural Protection) had the lowest mean of 2.4. There were no significant differences among group means. It was observed that operators with 16 to 29 years of farming experience had the highest mean of means of 2.99.

Table 8. Group means, standard deviations, F-values and F-probabilities of FSR&D-related factors according to years of education

Factor		Years of education (8-11)	(12)	(13-27)	Total	F-value	F-probability
Small-scale		n=20	n=86	n=74	N=180		
agriculture	M[a]	2.98	2.99	2.85	2.93	2.24	.1094
(Factor One)	SD[b]	.30	.37	.47	.41		
Crop/livestock		n=19	n=85	n=72	N=176		
integration		2.98	2.95	2.78	2.88	3.14	.0459
(Factor Two)		.42	.41	.49	.45		
Problem		n=19	n=86	n=74	N=179		
solving		2.81	3.09	3.10	3.07	3.28	.0400
(Factor Three)		.35	.46	.49	.47		
On-farm		n=20	n=86	n=73	N=179		
trial		2.83	3.07	2.98	3.01	2.44	.0905
(Factor Four)		.38	.43	.47	.44		
Agricultural		n=14	n=83	n=70	N=172		
protection		2.65	2.55	2.41	2.50	1.92	.1494
(Factor Five)		.58	.54	.59	.57		
Market		n=18	n=87	n=74	N=179		
information		3.14	3.09	3.03	3.07	.66	.5204
(Factor Six)		.15	.43	.46	.45		
Overall means		2.89	2.96	2.86	2.91		

[a]M = Mean.
[b]SD = Standard deviation.

Table 9. Group means, standard deviations, and analyses of variance for FSR&D-related factors by the number of years in operation

Factor		Number of years 1-15	16-29	30-39	40-56	Total	F-value	F-probability
Small-scale		n=57	n-41	n=38	n=41	N=177		
agriculture	M[a]	2.95	2.99	2.87	2.92	2.94	.64	.5901
(Factor One)	SD[b]	.39	.36	.45	.44	.41		
Crop/livestock		n=56	n=41	n=37	n=40	N=174		
integration		2.84	3.03	2.78	2.90	2.89	2.23	.0861
(Factor Two)		.41	.47	.41	.50			
Problem		n=57	n=42	n=38	n=39	N=176		
solving		3.15	3.11	2.93	3.03	3.07	2.04	.1096
(Factor Three)		.29*	.49	.59	.50	.47		
On-farm		n=57	n=42	n=36	n=41	N=176		
trial		2.99	3.15	2.88	3.01	3.01	2.55	.0573
(Factor Four)		.38	.50*	.50	.37	.44		
Agricultural		n=57	n=38	n=37	n=37	N=169		
protection		2.40	2.59	2.54	2.55	2.51	1.05	.3707
(Factor Five)		.53	.57	.66	.52	.57		
Market		n=57	n=42	n=38	n=40	N=177		
information		3.11	3.08	3.04	3.03	3.07	.38	.7706
(Factor Six)		.42	.44	.49	.46	.45		
Overall mean		2.91	2.99	2.84	2.91	2.92		

[a]M = Mean.
[b]SD = Standard deviation.

The group means, standard deviations, F-values and F-probabilities of FSR&D factors by annual income of farm operators are presented in Table 10. It was observed that operators with income of $30,001 to $40,000 had the mean score of 3.15, whereas those with $40,001 and above had the highest mean of 3.16. Factor Five (Agricultural Protection) was generally rated low among operators of different economic levels. Factor Two (Crop/Livestock Integration) had a moderate mean score except for farm operators with $20,001 and $30,000 annual income with a mean of 2.97. The overall mean of the means was observed to be 2.90. A significant difference beyond .05 was observed among means for Factor Five (Agricultural Protection). The Scheffé post-hoc test revealed that mean differences existed among farm operators with incomes of $20,000 or less and those with incomes between $20,001 and $30,000.

Data in Table 11 reveal FSR&D factors by age of farm operators. The overall mean of the means was 2.91 with the highest mean score for operators between 27 to 40 years of age. The lowest mean score was observed for farm operators between the ages of 60 and 68. It was observed that farm operators between the ages of 27 and 40 had the highest mean of 3.17 for Factor Three (Problem Solving) and 3.12 for Factor Six (Market Information). This group of farm operators equally had the lowest mean of 2.38 for Factor Five (Agricultural Protection) even though the idea of agricultural protection had a uniformly low rating across all ages.

Table 10. Means, standard deviations, F-values and F-probabilities for FSR&D-related factors by income of operators

Factor		Income: $20,000 or less	$20,001 to $30,000	$30,001 to $40,000	Over $40,000	Total	F-value	F-probability
Small-scale		n=43	n=49	n=30	n=46	N=168		
agriculture	M[a]	2.96	2.83	3.03	2.92	2.92	1.764	.1561
(Factor One)	SD[b]	.31	.51	.31	.39	.41		
Crop/livestock		n=44	n=47	n=30	n=44	N=165		
integration		3.50	2.84	2.86	2.86	2.89	1.23	.3017
(Factor Two)		.38	.57	.38	.36	.44		
Problem		n=44	n=49	n=30	n=44	N=165		
solving		3.00	2.97	3.07	3.22	3.06	2.34	.0756
(Factor Three)		.37	.61	.58	.31	.48		
On-farm		n=44	n=49	n=29	n=45	N=167		
trial		3.05	2.94	2.97	3.08	3.01	.76	.4113
(Factor Four)		.33	.58	.39	.43	.45		
Agricultural		n=41	n=48	n=29	n=42	N=160		
protection		2.71	2.39	2.42	2.49	2.50	2.71	.0469
(Factor Five)		.52	.66	.51	.50	.57		
Market		n=43	n=48	n=30	n=46	N=167		
information		3.02	2.95	3.15	3.16	3.00	2.39	.0711
(Factor Six)		.39	.46	.45	.44	.44		
Overall mean		2.96	2.82	2.92	2.96	2.90		

[a]M = Mean.
[b]SD = Standard deviation.

Table 11. Means, standard deviations, F-values, and F-probabilities for FSR&D by the age of operator

Factor		Age of operator 27-40 years	41-59 years	60-78 years	Total	F-value	F-probability
Small-scale		n=45	n=71	n=61	N=177		
agriculture	M[a]	2.99	2.93	2.90	2.93	.56	.5732
(Factor One)	SD[b]	.38	.43	.42	.41		
Crop/livestock		n=44	n=77	n=59	N=174		
integration		2.87	2.86	2.93	2.88	.39	.6756
(Factor Two)		.42	.45	.48	.45		
Problem		n=45	n=72	n=59	N=176		
solving		3.17	3.08	2.98	3.07	2.09	.1264
(Factor Three)		.27	.53	.49	.47		
On-farm		n=45	n=71	n=60	N=176		
trial		3.06	3.02	2.96	3.01	.68	.5100
(Factor Four)		.38	.54	.35	.44		
Agricultural		n=45	n=68	n=56	N=169		
protection		2.38	2.55	2.55	2.50	1.39	.2497
(Factor five)		.55	.61	.54	.57		
Market		n=45	n=72	n=60	N=177		
information		3.12	3.10	2.99	3.07	1.41	.2458
(Factor Six)		.43	.47	.44	.45		
Overall mean		2.93	2.92	2.89	2.91		

[a]M = Mean.
[b]SD = Standard deviation.

Present and Future Importance of Educational Subject Matter

The second objective of this study was to identify farming systems educational program areas, sources of farming information, and the extent of cooperation between farmers and public agencies. Data in Tables 12 to 19 address these issues. The instrument was designed to address the issues of present and future importance of listed agricultural subject matter.

Data in Table 12 reveal the means, standard deviations, and mean ranking of present and future importance of agricultural programs. Farm safety, record keeping, financial management, soil conservation, and agricultural marketing were the five top items with the means of 4.05, 4.04, 4.04, 4.02, and 4.01, respectively. Forest management and computer data analysis, with means of 2.65 and 2.86, respectively, were ranked lowest among subject matter programs. The table revealed a different order of importance of subject matter areas in the future. The respondents indicated that, in the future, the top five subject matter areas would be: (1) record keeping (mean = 4.36); (2) soil conservation (mean = 4.34); (3) financial management (mean = 4.32); (4) agricultural marketing (mean = 4.30); and (5) farm safety (mean = 4.26), arranged in descending order of importance. Horticulture and forest management had the lowest scores of 3.22 and 2.93, respectively.

Data in Table 13 reveal the means, standard deviations, and mean rankings of the importance of information sources. The top five information sources were radio, magazines, newsletters, agricultural shows, and meetings with item means of 3.80, 3.76, 3.62, 3.59, and 3.54,

Table 12. Mean, standard deviation, and mean rankings for the present and future importance of subject matter

Subject matter	Present Mean		Present S.D.	Present Mean rankings	Future Mean		Future S.D.	Future Mean rankings
Agricultural marketing	4.01	(184)[a]	0.89	5	4.30	(183)	0.87	4
Agriculture mechanics	3.50	(182)	0.79	14	3.64	(181)	0.82	17
Horticulture	3.01	(181)	0.95	19	3.22	(181)	1.06	20
Agric. sales/services	3.49	(183)	0.84	15	3.72	(182)	0.89	16
Agricultural processing	3.40	(182)	0.95	16	3.75	(182)	1.03	15
Forest management	2.65	(182)	1.25	21	2.93	(182)	1.35	21
Soil conservation	4.02	(184)	0.89	4	4.34	(182)	0.91	2
Environmental control	3.82	(184)	1.02	7	4.25	(182)	0.98	6
Farm safety	4.05	(184)	0.96	1	4.26	(182)	0.93	5
Record keeping	4.05	(184)	0.98	2	4.36	(182)	0.85	1
Pest management	3.79	(184)	0.87	8	4.09	(182)	0.83	8
Financial management	4.04	(184)	1.00	3	4.32	(180)	0.89	3
Computer data analysis	2.86	(179)	1.13	20	3.39	(178)	1.23	19
Biotechnology	3.17	(178)	1.02	17	3.79	(177)	0.99	13
Community development	3.16	(181)	0.97	18	3.46	(181)	0.96	18
New farming technique	3.55	(184)	0.87	11	3.95	(184)	0.86	11
Farm budgeting	3.52	(183)	0.95	13	3.84	(182)	0.95	12
Livestock production	3.53	(183)	1.06	12	3.77	(180)	1.05	14
Disease prevention	3.71	(183)	1.06	10	3.97	(180)	1.01	10
Machine maintenance	3.79	(183)	0.87	9	4.00	(181)	0.86	9
Economics of production	3.92	(184)	0.87	6	4.17	(182)	0.84	7
Grand mean	3.57		0.96		3.88		0.96	

[a]The figure in parentheses is the number of responses for that item.

respectively. State fairs and agricultural career days had the lowest mean scores of 3.03 and 3.04. The general outlook of information sources was observed with a grand mean of 3.42 and an overall standard deviation of 1.05.

Means, standard deviations, and mean rankings of the level of

Table 13. Mean, standard deviation and mean rankings of the importance of sources of information

Source of information	Mean		Standard deviation	Mean rank among item means
Magazines	3.76	(183)[a]	0.88	2
Radio	3.80	(184)	0.91	1
Television	3.34	(183)	1.09	11
Post office mail	3.27	(180)	1.03	12
Office visits	3.16	(180)	1.11	13
Bulletins	3.53	(184)	0.89	6
Newsletters	3.62	(184)	0.87	3
Meetings	3.54	(183)	0.91	5
Agricultural Career Days	3.04	(182)	1.07	14
State fairs	3.03	(184)	1.08	15
Workshops	3.39	(182)	0.98	8
Seminars	3.34	(183)	1.02	10
Newspapers	3.34	(182)	1.02	9
Demonstrations	3.53	(183)	0.96	7
Agricultural shows	3.59	(184)	0.98	4
Grand mean	3.42		1.05	

[a]The figure in parentheses is the number of responses for that item.

influence of certain private and public agencies which may influence day-to-day decision making of farm operators involved in the study are presented in Table 14. The agricultural stabilization service (ASS) had the highest mean score of 3.50, followed by farmers' cooperatives with a mean score of 3.37. Agricultural Research Service and Agricultural Extension Service had mean scores of 3.13 each and standard deviations of 1.03 and 1.06, respectively. The Iowa Department of Commerce had the lowest ranking with the item mean of 2.14 and standard deviation of 1.03. The reader should observe that the large influence of ASS in the farmers'

Table 14. Mean, standard deviation and mean rankings for the level of influence exerted by agencies on decision making process

Source of information	Mean		Standard deviation	Mean rank among item means
Farmers' Home Administration	1.96	(184)[a]	1.31	12
Soil/Water Conservation Service	2.94	(184)	1.00	8
Agricultural Extension Service	3.13	(184)	1.06	4
Agricultural Research Service	3.13	(182)	1.03	3
Agricultural Stabilization Service	3.50	(184)	0.99	1
Farm Bureau	2.35	(184)	1.14	9
Private scientists (consultants)	2.30	(184)	1.05	10
Department of Commerce, Iowa	2.14	(184)	1.03	11
Agricultural Experiment Station	2.95	(183)	1.14	7
Farmers' Cooperatives	3.37	(184)	1.03	2
Agribusiness companies	3.04	(183)	1.04	6
College/university researchers	3.13	(184)	1.09	5
Grand mean	2.83		1.08	

[a]The figure in parentheses is the number of responses for that item.

decision making did not come as a surprise because the population for this study was drawn from the ASS listings. Note also the influence of college/university researchers and Agricultural Extension Service (AES).

The data were subjected to factor analysis after due testing as outlined in Chapter III. Table 15 reveals the results of factor loadings of groupings of present importance of agricultural subject matter. Five factors were identified and were assigned specific names. Computer Data Analysis (Factor Two) had an alpha loading of .837. Items in Factor Three--Natural Resources had a factor loading score of .819 for environmental control and .813 for soil conservation. In Factor

Table 15. Factor loadings of groupings of present importance of agricultural subject matter/programs

Factor grouping	Loading
Factor One--Management	
Record keeping	.780
Financial management	.731
Economics of production	.671
Pest management	.645
Machine maintenance	.570
Farm budgeting	.505
Factor Two--Technology	
Computer data analysis	.837
Biotechnology	.782
Community development	.520
Factor Three--Natural Resources	
Environmental control	.819
Soil conservation	.813
Factor Four--Crop Production	
Agricultural sales/services	.700
Agricultural processing	.624
Agriculture mechanics	.619
Horticulture	.613
Factor Five--Livestock production	
Livestock production	.887
Disease prevention	.846

Five--Livestock Production, environmental control and disease prevention had the highest factor scores of .887 and .846, respectively. Farm budgeting had the lowest factor loading of .505. Again, the high factor loadings among grouped items indicated a uniform consistency in response to factor loadings.

Data in Table 16 reveal the factor loadings of future importance of

Table 16. Factor loadings of groupings of future importance of agricultural subject matter/programs

Factor grouping	Loading
Factor One--Management/Natural Resources	
Soil conservation	.769
Farm safety	.767
Environmental control	.764
Record keeping	.549
Factor Two--Future Technology	
Computer data analysis	.771
Biotechnology	.766
Farm budgeting	.605
Financial management	.512
Factor Three--Sales and Development	
Agricultural sales and services	.763
Agricultural marketing	.700
Agricultural mechanic	.568
Community development	.564
Factor Four--Future Livestock Production	
Disease prevention	.876
Livestock production	.793
Machine maintenance	.579
Factor Five--Future Crop Management	
Forest management	.807
Horticulture	.693

subject matter. Forest Management and Disease Prevention had factor loadings of .876 and .807, respectively. Factor loadings of other items were also high among factor groupings. Financial Management (Factor Two) had the lowest factor loading of .512.

Factor loadings for information sources are presented in Table 17. Three factors were identified and named: (1) Visual/Participatory

Table 17. Factor loadings of groupings of information sources

Factor grouping	Loading
Factor One--Visual/Participatory Sources	
Workshops	.800
Seminars	.771
Demonstrations	.763
Agricultural shows	.755
Meetings	.720
Agricultural Career Days	.686
State fairs	.585
Factor Two--Printed Sources	
Bulletins	.856
Newsletters	.824
Office visits	.660
Factor Three--News Media	
Radio	.747
Television	.703
Newspaper	.686

Sources; (2) Printed Sources; and (3) News Media. Again, workshops, bulletins, and newsletters had .800, .856, and .824 alphas, respectively. Most of the items were scored above .600 alpha level except for the use of state fair as an information source which had a factor loading of .585.

Data in Table 18 consist of factor loading groupings of private and public agencies which influence farmers' decision making in their farming operations. Note that the Agricultural Research Service and Agricultural Experiment Station in Factor One had high factor alpha loadings of .880 and .812, respectively. Farmers cooperatives had a higher factor loading of .813.

Table 18. Factor loadings of groupings of decision-making items

Factor grouping	Loading
Factor One--Institutional Agencies	
Agricultural Research Service	.880
Agricultural Experiment Station	.812
Agricultural Extension Service	.699
College/university researchers	.667
Factor Two--Government Establishment	
Department of Commerce, Iowa	.794
Farmers' Home Administration	.747
Farm Bureau	.681
Private scientists (consultants)	.677
Soil/Water conservation Service	.544
Factor Three--Cooperate Bodies	
Farmers' cooperatives	.813
Agribusiness company	.737
Agricultural Stabilization Service	.615

Analytical Results for Present and Future Importance of Subject Matter and the Information Source

Factor groupings were again subjected to further analysis using one-way analysis of variance. The results of these analyses are presented in Tables 19, 20, 21, and 22. Table 19 contains the results of analysis of variance of the present importance of subject matters by annual income of farm operators. There were no significant differences among the different economic groups with regard to their perception of subject matter group factors. Factor Three (Natural Resources) received the highest factor mean of 4.03 among operators within the annual income of $40,001 and above. It was interesting to note that the overall mean, 3.58, was scored by farm operators in the $20,001 and $30,000 income

Table 19. Means, standard deviations, F-values, F-probabilities and present importance of subject matter and programs by income

Factor		Income: $20,000 or less	$20,001 to $30,000	$30,001 to $40,000	$40,001 or more	Total	F-value	F-probability
Management		n=43	n=49	n=29	n=47	N=164		
(Factor One)	M[a]	3.66	3.91	3.84	3.97	3.85	1.53	.2040
	SD[b]	.61	.77	.84	,69	.73		
Technology		n=44	n=48	n=29	n=46	N=167		
(Factor Two)		2.99	3.04	3.09	3.14	3.06	.28	.8427
		.85	.87	.87	.87	.86		
Natural		n=45	n=50	n=30	n=47	N=172		
Resources		3.94	3.85	3.80	4.03	3.92	.52	.6675
(Factor Three)		.84	.85	1.01	.95	.90		
Crop		n=42	n=47	n=30	n=46	N=165		
Production		3.42	3.24	3.48	3.27	3.34	1.28	.2842
(Factor Four)		.68	.66	.64	.51	.62		
Livestock		n=44	n=50	n=30	n=47	N=171		
Production		3.48	3.84	3.58	3.46	3.59	1.58	.1960
(Factor Five)		.98	.99	.91	.99	.98		
Overall mean		3.50	3.58	3.56	3.57	3.55		

[a]M = Mean.
[b]SD = Standard deviation.

range followed by operators with incomes of $40,000 and above with a mean of 3.57. Notice that Technology (Factor Three) had the lowest factor mean rating of 2.99 for those operators with incomes of $20,000 or less. Factors Three, Four, and Five had relatively high mean scores.

Data in Table 20 make the same comparisons for future importance of educational subject matter. Farmers within the annual income of $40,000

Table 20. Means, standard deviations, F-values, and F-probabilities of future importance of subject matter and programs by income

Factor		Income: $20,000 or less	$20,001 to $30,000	$30,001 to $40,000	$40,001 or more	Total	F-value	F-probability
Natural		n=45	n=49	n=30	n=47	N=171		
Resources	M[a]	4.28	4.32	4.15	4.36	4.29	.49	.6869
(Factor One)	SD[b]	.83	.68	.93	.63	.75		
Technology		n=44	n=47	n=28	n=46	N=165		
(Factor Two)		3.64	3.94	3.69	3.99	3.83	2.05	.1092
		.74	.88	.81	.68	.79		
Sales and		n=43	n=48	n=30	n=46	N=167		
Services		3.70	3.68	3.83	3.88	3.77	1.07	.3618
(Factor Three)		.64	.69	.61	.57	.63		
Livestock		n=43	n=49	n=28	n=47	N=167		
Production		3.85	4.04	3.82	3.77	3.88	1.00	.3940
(Factor Four)		.82	.82	.69	.88	.82		
Crop		n=44	n=48	n=30	n=47	N=169		
Production		3.49	3.07	3.88	2.80	3.08	3.94	.0096
(Factor Five)		1.00	1.08	1.08	.94	1.05		
Overall mean		3.79	3.81	3.87	3.76	3.77		

[a]M = Mean.
[b]SD = Standard deviation.
*Significant at the 0.05 level.

per annum rated Factor One (Natural Resources) very highly. Factor Three (Sales and Services) was scored uniformly among economic groupings. Notice that Factor Two (Technology) did not receive a high mean score, even among the lower income group of farm operators. The importance of livestock in the future was scored very high with the mean of 4.04 as perceived by farmers in the annual income range of $20,001 and $30,000. Significant differences occurred among income group means under Factor Five (Crop Production). Scheffé post-hoc test indicated a significant difference between farmers with an annual income of $20,000 or less and those with incomes of $20,001 and $30,000. It was observed that farmers within the $20,001 and $30,000 range scored high in the present and future importance of subject matter--3.84 and 4.04, respectively.

The results of data analysis of factors relating to information sources by economic status of farmers were tabulated in Table 21. Three factors were generated. The use of News Media--Factor Three received the highest mean score of 3.54 among farmers with annual income of $20,000 or

Table 21. Means, standard deviations, F-values, and F-probabilities for factors relating to information sources by income

Factor		Income				Total	F-value	F-probability
		$20,000 or less	$20,001 to $30,000	$30,001 to $40,000	$40,001 or more			
Visual/Participatory Sources (Factor One)		n=44	n=48	n=27	n=46	N=165		
	M[a]	3.46	3.33	3.25	3.32	3.35	.44	.6905
	SD[b]	.68	.73	.73	.84	.75		
Printed Matter (Factor Two)		n=41	n=50	n=30	n=47	N=168		
		3.34	3.42	3.35	3.44	3.39	.17	.9139
		.79	.87	.74	.68	.77		
News Media (Factor Three)		n=44	n=50	n=30	n=46	N=170		
		3.54	3.49	3.50	3.35	3.47	.54	.6538
		.69	.81	.69	.81	.76		
Overall mean		3.45	3.40	3.37	3.37	3.40		

[a]M = Mean.
[b]SD = Standard deviation.

less. Farmers under this income range had a mean of means of 3.45 for all three factor groups. The use of printed matter was uniformly scored across economic ranges.

Table 22 contains results of analysis of factor loadings relating to decision-making items by income. The three factor loadings were Institutional Agencies (Factor One); Government Establishments (Factor Two); and Corporations (Factor Three). The use of corporation was scored highly by farmers within the income ranges of $20,001 and $30,000 and over $40,001 with mean scores of 3.47 and 3.36, respectively. Farmers within the $20,001 and $30,000 income range had a mean of means of 2.94. The lowest mean score of 2.24 was observed for Factor Two (Government Establishments) for farmers whose income was $40,001 or more.

Table 22. Means, standard deviations, F-values and F-probabilities of factor loading on decision making by income

Factor		Income				Total	F-value	F-probability
		$20,000 or less	$20,001 to $30,000	$30,001 to $40,000	$40,001 or more			
Institutional		n=44	n=50	n=30	n=45	N=169		
Agencies	M[a]	2.97	3.04	3.07	3.13	3.05	.25	.8594
(Factor One)	SD[b]	.88	.77	.95	.84	.85		
Government		n=45	n=50	n=30	n=47	N=172		
Establishment		2.39	2.32	2.42	2.24	2.34	.41	.7433
(Factor Two)		.83	.81	.75	.84	.81		
Corporation		n=44	n=50	n=30	n=47	N=171		
(Factor Three)		3.20	3.47	3.16	3.36	3.31	1.44	.2336
		.82	.74	.83	.74	.78		
Overall mean		2.89	2.94	2.88	2.91	2.90		

[a]M = Mean.
[b]SD = Standard deviation.

Tables 23, 24, 25 and 26 reveal the results of analysis of variance with factors relating to the importance of the present and future importance of subject matter, factors relating to information sources, and factors relating to decision making by the educational level of farm operators. In Table 23, the highest mean was observed among operators with 12 years of college education for Factor Three (Natural Resources)

Table 23. Group means, standard deviations, F-values and F-probabilities for factors relating to present importance of subject matter according to years of education

Factor		Years of education			Total	F-value	F-probability
		8-11	12	13-27			
Management		n=20	n=85	n=76	N=181		
(Factor One)	M[a]	3.77	3.89	3.85	3.86	.23	.7930
	SD[b]	.72	.72	.75	.73		
Technology		n=19	n=84	n=75	N=178		
(Factor Two)		3.18	3.07	3.02	3.06	.26	.7682
		.96	.75	.90	.83		
Natural		n=20	n=88	n=76	N=184		
Resources		3.80	3.98	3.88	3.92	.45	.6412
(Factor Three)		.94	.94	.85	.90		
Crop		n=20	n=84	n=73	N=177		
Production		3.29	3.42	3.29	3.36	.93	.3967
(Factor Four)		.79	.59	.63	.63		
Livestock		n=18	n=88	n=76	N=182		
Production		3.86	3.59	3.58	3.62	.61	.5440
(Factor Five)		.96	1.04	.94	.99		
Overall mean		3.58	3.59	3.52	3.62		

[a]M = Mean.
[b]SD = Standard deviation.

with the mean of 3.98 and a standard deviation of .94. Factor One (Management) received relatively higher mean scores (3.77, 3.89, and 3.85) across all levels of college education. In contrast, Factor Two (Technology) received relatively lower mean scores among different educational categories (3.18, 3.07, 3.02).

Data in Table 24 reveal the means, standard deviations, F-values, and F-probabilities for the future importance of subject matter. Factor

Table 24. Group means, standard deviations, F-values, and F-probabilities for factors relating to future importance of subject matter by years of education

Factor		Years of education			Total	F-value	F-probability
		8-11	12	13-27			
Natural		n=19	n=88	n=75	N=182		
Resources	M[a]	4.36	4.29	4.29	4.30	.06	.9431
(Factor One)	SD[b]	.88	.81	.63	.74		
Technology		n=18	n=82	n=75	N=175		
(Factor Two)		3.77	3.81	3.88	3.83	.23	.7956
		.83	.81	.75	.78		
Sales and		n=18	n=86	n=74	N=178		
Services		3.63	3.79	3.80	3.78	.59	.5546
(Factor Three)		.75	.60	.64	.63		
Livestock		n=17	n=86	n=74	N=177		
Production		4.14	3.94	3.79	3.90	1.43	.2428
(Factor Four)		.71	.85	.83	.83		
Crop		n=20	n=86	n=74	N=180		
Production		3.20	3.09	3.03	3.08	.24	.7851
(Factor Five)		1.08	.98	1.10	1.04		
Overall mean		3.82	3.78	3.76	3.78		

[a]M = Mean.
[b]SD = Standard deviation.

Four (Livestock Production) had the highest mean of 4.17. It is interesting to notice that all means in Factor One (Natural Resources) were higher with an overall mean of 4.30. Sales and Services had the lowest mean score of 3.63 for farm operators with 8 and 11 years of college education.

Table 25 shows the results of data analysis of factors by years of college education. Generally, there were no means below 3.00 among all factors. There was a significant difference beyond the .05 alpha level among farm operators' group means for Factor Three (News Media). A Scheffé post-hoc test indicated that the differences existed between

Table 25. Group means, standard deviations, F-value and F-probabilities for factors relating to information sources according to years of education

Factor		Years of education			Total	F-value	F-probability
		8-11	12	13-27			
Visual/Participatory Sources (Factor One)		n=19	n=84	n=74	N=177		
	M[a]	3.44	3.40	3.28	3.36	.64	.5269
	SD[b]	.78	.74	.79	.76		
Printed Matter (Factor Two)		n=18	n=86	n=76	N=180		
		3.39	3.44	3.42	3.43	.04	.9653
		.75	.82	.78	.79		
News Media (Factor Three)		n=18	n=87	n=76	N=181		
		3.98	3.60	3.27	3.50	8.24	.0004
		.56	.75	.75	.76		
Overall mean		3.60	3.48	3.32	3.43		

[a]M = Mean.
[b]SD = Standard deviation.

those respondents with 8 to 11 years of college education and those with 13 or more years of college education, and between those respondents with 12 years of college education and those with 13 to 27 years of college education.

Data in Table 26 reveal the result of factor analysis for private and public agencies which may influence operators' day-to-day decision making on the farms. Factor Two had the lowest mean among different educational levels. The lowest mean was observed for those respondents with 12 years of formal education in the use of Government Establishments (Factor Two).

Table 26. Means, standard deviations, F-values and F-probabilities of factor loading on decision making items by education

Factor		Years of education			Total	F-value	F-probability
		8-11	12	13-27			
Institutional		n=20	n=86	n=75	N=181		
Agencies	M[a]	3.10	3.09	3.06	3.08	.03	.9750
(Factor One)	SD[b]	.96	.91	.83	.88		
Government		n=20	n=88	n=76	N=184		
Establishments		2.59	2.28	2.33	2.33	1.18	.3084
(Factor Two)		.96	.74	.84	.81		
Corporation		n=20	n=87	n=76	N=183		
(Factor Three)		3.25	3.28	3.35	3.30	.24	.7862
		.88	.78	.73	.7		
Overall mean		2.98	2.88	2.91	2.90		

[a]M = Mean.
[b]SD = Standard deviation.

The number of years farmers have been in operation was used as an independent variable to analyze the data on subject matter items, sources of information, and decision making. Data in Tables 27, 28, 29, and 30 reveal the results of these analyses. Table 27 contains results of analysis of the present importance of subject matter factors. Operators between 40 to 56 years of operation for Factor One (Management) and Factor Three (Natural Resources) had means of 4.00 and 4.04,

Table 27. Group means, standard deviations, and analyses of variance for factors relating to the present importance of subject matter by number of years in operation

Factor		Number of years				Total	F-value	F-probability
		1-15	16-29	30-39	40-56			
Management		n=57	n=42	n=39	n=40	N=178		
(Factor One)	M[a]	3.80	3.93	3.77	4.00	3.87	.97	.4071
	SD[b]	.80	.61	.73	.67	.72		
Technology		n=57	n=42	n=38	n=38	N=175		
(Factor Two)		3.07	3.21	2.87	3.05	3.06	1.14	.3357
		.74	1.01	.74	.86	.84		
Natural		n=58	n=42	n=39	n=42	N=181		
Resources		3.91	3.93	3.85	4.04	3.93	.32	.8128
(Factor Three)		.82	1.02	.92	.88	.89		
Crop		n=56	n=41	n=39	n=38	N=174		
Production		3.34	3.41	3.29	3.39	3.36	.28	.8375
(Factor Four)		.53	.65	.71	.67	.63		
Livestock		n=58	n=42	n=39	n=40	N=179		
Production		3.62	3.52	3.47	3.86	3.62	1.21	.3078
(Factor Five)		.87	1.08	1.05	.99	.99		
Overall mean		3.55	3.60	3.45	3.67	3.57		

[a]M = Mean.
[b]SD = Standard deviation.

respectively. Factors Four and Five had similar mean scores irrespective of years in operation. Technology had the lowest mean score of 2.87 for farmers who have been in operation for 30 to 39 years. The overall mean of means score was 3.57, with the highest mean score for operators with 40 to 56 years of experience. The lowest mean score was observed for farmers with 30 to 39 years of operation.

Data in Table 28 reveal the factor means, standard deviations, F-values and F-probabilities of factors related to the future importance of subject matter. Factor One (Natural Resources) had uniform ratings among farm operators of all categories, followed by Factor Four (Livestock Production) with an overall mean score of 3.90 and standard deviation of .83. The mean of means score was 3.78. It was interesting to note that farmers with 1 to 15 years of farming experience had a mean of 4.08 for Factor Two (Technology), and those with 40 to 56 years of experience had the same mean score of 4.08 for Factor Four (Livestock Production). Factor Two (Technology) had significant differences among means beyond the .05 alpha level. A Scheffé post-hoc analysis identified significant differences between farmers with 1 to 15 years of operation and those with 30 to 39 years of operation. Farmers with 1 to 15 years of experience had a mean score of 4.08, standard deviation of .63, F-value of 3.78, and the F-probability of .0117, while operators with 30 to 39 years of experience had a mean of 3.57, and a standard deviation of .84.

Presented in Table 29 are the means, standard deviations, F-values, and F-probabilities for information source factors. The three factors identified had similar mean scores among farmers with differing

Table 28. Group means, standard deviations, and analyses of variance for future importance of subject matter by number of years of experience

Factor		Number of years in operation 1-15	16-29	30-39	40-56	Total	F-value	F-probability
Natural		n=57	n=42	n=39	n=42	N=180		
Resources	M[a]	4.42	4.22	4.11	4.42	4.31	1.84	.1416
(Factor One)	SD[b]	.69	.79	.81	.65	.74		
Technology		n=57	n=42	n=38	n=36	N=173		
(Factor Two)		4.08	3.82	3.57	3.72	3.83	3.78	.0117
		.63	.80	.84	.80	.78		
Sales and		n=56	n=41	n=39	n=40	N=176		
Services		3.79	3.89	3.64	3.78	3.78	1.11	.3462
(Factor Three)		.60	.69	.64	.59	.63		
Livestock		n=56	n=41	n=39	n=39	N=175		
Production		3.92	3.96	3.65	4.08	3.90	1.91	.1298
(Factor Four)		.79	.79	.89	.81	.83		
Crop		n=57	n=42	n=38	n=40	N=177		
Production		3.31	2.95	2.85	3.12	3.08	1.73	.1631
(Factor Five)		.93	1.13	1.04	1.09	1.05		
Overall mean		3.84	3.77	3.56	3.82	3.78		

[a]M = Mean.
[b]SD = Standard deviation.

Table 29. Group means, standard deviations, F-values and F-probabilities for factors relating to information sources by number of years in operation

Factor		Number of years 1-15	16-29	30-39	40-56	Total	F-value	F-probability
Visual/Participatory Sources (Factor One)		n=56	n=42	n=38	n=38	N=174		
	M[a]	3.38	3.31	3.28	3.42	3.35	.29	.8352
	SD[b]	.53	1.05	.72	.73	.76		
Printed Matter (Factor Two)		n=58	n=42	n=39	n=38	N=177		
		3.39	3.51	3.33	3.48	3.42	.42	.7393
		.76	.85	.79	.82			
News Media (Factor Three)		n=58	n=42	n=39	n=39	N=178		
		3.35	3.58	3.36	3.75	3.19	2.69	.0474
		.77	.79	.76	.73	.77		
Overall mean		3.37	3.47	3.32	3.55	3.32		

[a]M = Mean.
[b]SD = Standard deviation.

experiences. However, farmers with 40 to 56 years of operation had a grand mean of 3.55, followed by those with 16 to 29 years of farming experience with a grand mean of 3.47. There were no significant differences among group means.

Data in Table 30 reveal the means, standard deviations, F-values and F-probabilities for factors relating to "decision making." Factor Three (Corporations) had fairly uniform mean scores among farm operators with different years of experience. It was interesting to observe that the lowest mean score among farm operators was for Factor Two. The lowest mean score was observed for farmers with 30 to 39 years of farming

Table 30. Group means, standard deviations, F-values and F-probabilities for factors relating to decision making by number of years in operation

Factor		Number of years 1-15	16-29	30-39	40-56	Total	F-value	F-probability
Institutional		n=58	n=40	n=39	n=41	N=178		
Agencies	M[a]	2.92	3.04	3.15	3.28	3.08	1.54	.2061
(Factor One)	SD[b]	.81	.85	.79	1.03	.87		
Government		n=58	n=42	n=39	n=42	N=181		
Establishments		2.27	2.38	2.25	2.38	2.31	.35	.7915
(Factor Two)		.81	.79	.76	.84	.79		
Corporation		n=58	n=42	n=38	n=42	N=180		
Bodies		3.24	3.42	3.31	3.24	3.29	.53	.6591
(Factor Three)		.78	.84	.66	.79	.77		
Overall mean		2.81	2.95	2.90	2.96	2.87		

[a]M = Mean.
[b]SD = Standard deviation.

experience. Further analysis was conducted to determine the relationship of age of farm operators to the factors studied. Tables 31, 32, 33, and 34 contain the results of analysis for the present and future importance of agricultural subject matter, the information sources, and the influence on decision making by private and public agencies by the age of operators.

Data in Table 31 reveal the result of data analysis of present importance of listed subject matter factors by age of farm operators. Factor One (Management) had higher means among different age groups when compared to other factor group means. Factor Three (Natural Resources),

Table 31. Means, standard deviations, F-values and F-probabilities of present importance of subject matter by age of operators

Factor		Age of operator 27-40	41-59	60-67	Total	F-value	F-probability
Management		n=46	n=72	n=60	N=178		
(Factor One)	M[a]	3.93	3.89	3.79	3.87	.60	.5489
	SD[b]	.70	.72	.73	.72		
Technology		n=45	n=72	n=58	N=175		
(Factor Two)		3.07	3.18	2.90	3.06	1.70	.1844
		.76	.89	.83	.84		
Natural		n=46	n=73	n=62	N=181		
Resources		3.93	3.99	3.84	3.92	.46	.6333
(Factor Three)		.69	.98	.93	.89		
Crop		n=44	n=72	n=58	N=174		
Production		3.39	3.34	3.36	3.36	.09	.9053
(Factor Four)		.50	.68	.66	.63		
Livestock		n=46	n=73	n=60	N=179		
Production		3.61	3.65	3.61	3.63	.04	.9623
(Factor Five)		.90	1.01	1.05	.99		
Overall mean		3.59	3.61	3.50	3.57		

[a]M = Mean.
[b]SD = Standard deviation.

however, excelled in the overall mean comparison. The highest mean score of 3.99 was for operators between the age of 41 and 59. The factor with the lowest group mean was Factor Two (Technology), with a mean of 3.07 for operators within the age of 60 and 67. The mean of means was 3.57. Crop and livestock factors had mean scores that were moderate in value with Factor Five (Livestock Production) having a mean of 3.65 for farm operators within the ages of 41 to 59.

The results of data in Table 32 contain the future importance of subject matter as perceived by different categories of farm operators. Significant differences were observed for Factor Two (Technology). The Scheffé post-hoc test of significance revealed significant difference beyond the .05 alpha level for farm operators between the ages of 27 and 40 and those within the ages of 60 and 78. In this table, the highest

Table 32. Means, standard deviations, F-values, and F-probabilities for future importance of agricultural subject matter according to the age of the operators

Factor		Age of operator			Total	F-value	F-probability
		27-40	41-59	60-78			
Natural		n=45	n=73	n=62	N=180		
Resources	M[a]	4.44	4.31	4.19	4.30	1.51	.2234
(Factor One)	SD[b]	.69	.71	.79	.74		
Technology		n=45	n=72	n=56	N=173		
(Factor Two)		4.05	3.89	3.59	3.84	4.61	.0112
		.70	.77	.81	.78		
Sales and		n=44	n=72	n=60	N=176		
Services		3.81	3.83	3.69	3.78	.91	.4046
(Factor Three)		.58	.66	.63	.63		
Livestock		n=45	n=70	n=60	N=175		
Production		3.88	3.92	3.92	3.91	.03	.9685
(Factor Four)		.79	.82	.88	.83		
Crop		n=45	n=72	n=60	N=177		
Production		3.29	2.99	3.07	3.09	1.25	.2904
(Factor Five)		.91	1.09	1.07	1.04		
Overall mean		3.89	3.79	3.69	3.78		

[a]M = Mean.
[b]SD = Standard deviation.

mean score of 4.44 was observed for Factor One (Natural Resources) for farm operators whose ages were between 27 and 40. The lowest mean was observed for Factor Five (Crop Production) for farm operators within the age range of 41 and 59. The mean of means (3.89) was highest for this category of farmers.

Data in Table 33 contain results of data analysis of sources of information by age of operators. The similarity among different age groups in the use of different sources of information was observed in the mean pattern. The use of news media had the highest mean of 3.74 among operators between the ages of 60 and 78. It was interesting to note the trend in the mean scores among operators within the age of 27 and 40 in

Table 33. Means, standard deviations, F-values and F-probabilities of factor relating to information sources

Factor		Age of operator			Total	F-value	F-probability
		27-40	41-59	60-78			
Visual/Partici-		n=45	n=72	n=58	N=175		
patory Sources	M[a]	3.48	3.32	3.32	3.36	.72	.4868
(Factor One)	SD[b]	.57	.86	.78	.78		
Printed		n=46	n=73	n=58	N=177		
Matter		3.46	3.41	3.42	3.43	.05	.9492
(Factor Two)		.86	.76	.82	.79		
News		n=46	n=73	n=59	N=178		
Media		3.34	3.41	3.74	3.49	4.36	.0143
(Factor Three)		.68	.80	.77	.77		
Overall mean		3.43	3.38	3.49	3.43		

[a]M = Mean.
[b]SD = Standard deviation.

their use of visual/participatory sources of information (mean = 3.48), and their use of printed matter (mean = 3.46). Information source mean scores increased with the increase in age for Factor Three (News Media) and these means were hence the significant difference beyond the .05 alpha level. A Scheffé post-hoc test indicated significant difference between farm operators within the ages of 27 to 40 and 60 to 78.

The result of analysis of decision making by age of operators is tabulated in Table 34. Here Factor Three (Corporation) had mean scores of 3.36 for farm operators between the ages of 27 and 40, and those under 60 and 78. The lowest mean was observed for Factor Two (Government

Table 34. Means, standard deviations, F-values and F-probabilities of factors relating to decision making by the age of operators

Factor		Age of operator			Total	F-value	F-probability
		27-40	41-59	60-78			
Institutional		n=46	n=71	n=61	N=178		
Agencies	M[a]	2.83	3.13	3.22	3.08	2.86	.0597
(Factor One)	SD[b]	.85	.83	.90	.87		
Government		n=46	n=73	n=62	N=181		
Establishments		2.27	2.36	2.32	2.32	.16	.8507
(Factor Two)		.83	.81	.81	.81		
Corporation		n=46	n=73	n=61	N=180		
(Factor Three)		3.36	3.36	3.19	3.30	.83	.4359
		.78	.75	.81	.78		
Overall mean		2.82	2.95	2.91	2.90		

[a]M = Mean.
[b]SD = Standard deviation.

Establishments) with a mean of 2.27 for operators between the ages of 27 and 40. The highest mean of means (2.95) was observed for operators between the ages of 41 to 59.

The third objective of this study was to identify the deficiencies and constraints of the existing farming systems as perceived by farmers with implication for agricultural education. In order to achieve this objective, Part Two (Section A)--Constraint, and Part Three (Section C) "Marketing Outlet" were designed and data obtained from the respondents. Farmers were directed to rate the listed items on a scale of 1 to 5. Data collected were then analyzed to accomplish the desired goal.

Data in Table 35 contain the means, standard deviations and mean rankings for the items under "Constraints". Pricing Methods of Agricultural Products had the highest mean of 3.58 and a standard deviation of .98 and was ranked number one followed by Government Agricultural Policy with a mean score of 3.56. Other items among the top five major constraints were International Market System; Agribusiness/ Multi-Corporations and Different Agricultural Programs ranked third, fourth, and fifth, respectively. The location of the respondents' farms and the information system had the lowest ranking with means of 2.47 and 2.69, respectively.

The data were then subjected to factor analysis which grouped the items into three factors: (1) Factor One (External Constraints); (2) Factor Two (Research Information); and (3) Factor Three (Financial Constraints) as shown in Table 36. Government agricultural policies had the highest alpha loading of .823 followed by Pricing Method of

Table 35. Means, standard deviations, and mean rankings for constraints limiting agricultural production

Constraint	Mean		Standard deviation	Mean rank among constraint means
Agricultural marketing system	3.20	(184)[a]	0.99	6
Agricultural credit system	2.81	(180)	1.14	8
Transportation system	2.73	(181)	1.05	10
Location of your farm	2.47	(180)	1.11	12
Information system	2.69	(179)	0.94	11
International market system	3.47	(180)	1.03	3
Pricing method of agricultural products	3.58	(181)	0.98	1
Government agricultural policies	3.56	(181)	1.00	2
Different agricultural programs	3.21	(178)	0.89	5
Agricultural input system	2.92	(174)	0.86	7
Research methodologies	2.74	(174)	0.87	9
Agribusiness/multi-Corporations	3.34	(179)	1.11	4
Grand mean	3.06		.99	

[a]The number in parentheses is the number of responses in that item.

Agricultural Products with a .784 alpha. Factor Two, "Research Methodologies", had the highest alpha loading of .800. It was interesting to observe that items in Factor Three (Agricultural Credit System, Agricultural Market System, and Transportation System) had factor loadings above .600 even though they received lower rankings among item means (Table 36).

The factors were again subjected to further analysis. The results of analysis of variance of factors by farmers' age, income, years of formal education, and number of years in operation are presented in

Table 36. Factor loadings of groupings of constraints

Factor grouping	Loading
Factor One--External Constraints	
Government agricultural policies	.823
Pricing method of agricultural products	.784
Different agricultural policies	.743
Agribusiness/multi-corporation	.623
International market system	.573
Factor Two--Research Information	
Research methodologies	.800
Information system	.686
Location of your farm	.594
Agricultural input system	.581
Factor Three--Financial Constraint	
Agricultural credit system	.686
Agricultural market system	.680
Transportation systems	.658

Tables 37, 38, 39, and 40.

Means, standard deviations, F-values and F-probabilities for constraint factors by age of farmers are presented in Table 37. Factor One (External Constraint) had higher means when compared to other factors. For this factor, farmers between the ages of 41 and 59 had the highest mean score of 3.51. The highest mean of the means was observed for respondents between the ages of 60 and 78. Significant differences beyond the assigned .05 alpha were observed among factor means for Factor Two (Research Information). The Scheffé post-hoc test revealed that significant differences occurred between farmers between the ages of 41 and 59 and farmers between the ages of 60 and 78. A significant

Table 37. Means, standard deviations, F-values and F-probabilities for factors relating to constraints by age of respondents

Factor		Age of operator			Total	F-value	F-probability
		27-40	41-59	60-78			
External		n=44	n=71	n=58	N=173		
Constraints	M[a]	3.49	3.51	3.31	3.44	1.25	.2889
(Factor One)	SD[b]	.68	.78	.67			
Research		n=45	n=68	n=53	N=166		
Information		2.71	2.56	2.89	2.71	3.56	.0306
(Factor Two)		.55	.66	.74	.67		
Financial		n=46	n=72	n=59	N=177		
Constraint		2.86	2.90	2.94	2.91	.12	.8896
(Factor Three)		.62	.87	.84	.79		
Overall mean		3.02	2.99	3.05	3.02		

[a]M = Mean.
[b]SD = Standard deviation.

difference among these groups of farmers was expected as younger farmers tend to have more access to research information than do the older farmers. The highest mean of means was observed for the farmers between the ages of 60 to 78.

Means, standard deviations, F-values, and F-probabilities for constraint factors by income of farmers are presented in Table 38. The overall mean of means was 3.02. The highest mean of means (3.13) was observed for farmers within the annual income range of $30,001 to $40,000. It was observed that Factor Two had the lowest mean ratings compared to other factors with slight mean differences among different

Table 38. Means, standard deviations, F-values and F-probabilities constraint factors by income

Factor		Income: $20,000 or less	$20,001 to $30,000	$30,001 to $40,000	$40,001 or more	Total	F-value	F-probability
External		n=42	n=49	n=28	n=45	N=164		
Constraint	M[a]	3.39	3.40	3.62	3.47	3.45	.74	.5272
(Factor One)	SD[b]	.70	.72	.77	.72	.72		
Research		n=39	n=49	n=27	n=43	N=158		
Information		2.69	2.74	2.76	2.64	2.71	.21	.8886
(Factor Two)		.67	.74	.68	.68	.69		
Financial		n=43	n=50	n=29	n=46	N=168		
Constraint		2.73	2.97	3.00	2.95	2.91	1.02	.3843
(Factor Three)		.66	.80	.89	.83	.79		
Overall mean		2.94	3.04	3.13	3.02	3.02		

[a]M = Mean.
[b]SD = Standard deviation.

income groups.

Data in Table 39 reveal the means, standard deviations, F-values, and F-probabilities for constraint factors by the number of years of education. It was observed that significant differences existed among factor means in both Factor Two (Research Information) and Factor Three (Financial Constraint) beyond the .05 alpha level. The Scheffé post-hoc test revealed significant differences between farmers with 8 to 11 years of formal education and those with 13 to 27 years of formal education for Factor Two. Farmers with 8-11 years of education had a mean score of 3.05 and a standard deviation of .57 and an F-probability of .0105.

Table 39. Group means, standard deviations, F-values and F-probabilities for constraint factors by years of education

Factor		Years of education 8-11	12	13-27	Total	F-value	F-probability
External		n=19	n=83	n=74	N=176		
Constraint	M[a]	3.21	3.48	3.46	3.44	1.13	.3264
(Factor One)	SD[b]	.55	.76	.71	.72		
Research		n=15	n=82	n=72	N=169		
Information		3.05	2.81	2.55	2.72	4.68	.0105
(Factor Two)		.57	.71	.63	.69		
Financial		n=18	n=86	n=76	N=180		
Constraint		3.04	3.07	2.71	2.92	4.31	.0149
(Factor Three)		.79	.80	.77	.80		
Overall mean		3.10	3.12	2.91	3.03		

[a]M = Mean.
[b]SD = Standard deviation.

There were also significant differences among means for Factor Three. A post-hoc test revealed significant differences between farmers with 12 years of formal education and those with 13 to 27 years of formal education. This difference was unexpected. However, it seems that the higher the educational status of a farmer, the lesser the financial constraint observed. It was interesting to observe that farmers with less number of years of formal education had less problem with external constraint--Factor One where the mean score was 3.21 compared to other means. It is interesting to note that all economic groups recognized the influence of external forces militating against their farming operations.

Data in Table 40 contain the means, standard deviations, F-values, and F-probabilities of factors related to constraints by years of operation. The mean of means score was observed to be 3.03. Farmers with 1 to 15 years of farming experience had the highest mean score of 3.55 in Factor One, followed by farmers with 30 to 39 years of farming experience with the mean of 3.44. Factor Three had fairly similar means among all groups in terms of financial constraints although the means were lower. Factor One had a mean of 3.45 with an overall standard deviation of .73. The mean scores for Factor Two tend to support the earlier observation in Table 35 that farmers with 40 to 56 years of farming experience felt that availability of research information was

Table 40. Group means, standard deviations, and analyses of variance for factors relating to constraints by years in operation

Factor		Number of years 1-15	16-29	30-39	40-56	Total	F-value	F-probability
External		n=57	n=40	n=38	n=38	N=173		
Constraint	M[a]	3.55	3.39	3.44	3.36	3.45	.68	.5675
(Factor One)	SD[b]	.65	.95	.64	.65	.73		
Research		n=57	n=37	n=36	n=36	N=166		
Information		2.70	2.62	2.57	2.99	2.72	2.74	.0454
(Factor Two)		.57	.74	.73	.72			
Financial		n=58	n=41	n=39	n=39	N=177		
Constraints		2.93	2.76	2.96	3.01	2.92	.76	.5166
(Factor Three)		.69	.85	.95	.76	.81		
Overall mean		3.06	2.92	2.99	3.12	3.03		

[a]M = Mean.
[b]SD = Standard deviation.

a constraint.

To further accomplish the purpose of the third objective of this study, items were listed under the heading "Marketing Outlet" to address the second part of this objective--"Deficiencies in the Existing Farming Systems." The means, standard deviations, and mean rankings of items for this listing are presented in Table 41. Grain Elevators with the mean of 4.11 and a standard deviation of 1.12 ranked number one among listed marketing outlets by farmers in the study. The use of Cooperatives came second with a mean score of 4.06. It was observed that the use of Local Food Store as a marketing outlet had the lower mean score of 1.61. It was noted that, with the exception of Farmers' Cooperatives and Grain

Table 41. Means, standard deviations and mean rankings for the likelihood of farmers using listed marketing outlet

"Marketing outlet"	Mean		Standard deviation	Mean rank among item means
Government agencies	2.35	(182)[a]	1.19	5
Agribusiness companies	2.69	(182)	1.27	3
Farmers' cooperatives	4.06	(184)	1.09	2
Feed companies	2.30	(181)	1.21	6
Private individuals	2.46	(182)	1.19	4
Neighbors	2.17	(180)	1.13	7
Local food stores	1.61	(182)	0.97	9
Roadside sales	1.44	(181)	0.78	10
Grain elevators	4.11	(183)	1.12	1
Customers at your home	1.86	(182)	1.09	8
Grand mean	2.51		1.10	

[a]The figure in parentheses is the number of responses for each item.

Elevators, mean scores were generally low for the use of other marketing avenues. It was interesting to note that even government agencies scored low among other means.

These items were then subjected to factor analysis. The results of factor analysis are presented in Table 42. The marketing outlet items were grouped into three factors--Local Outlet, Corporations, and Other agencies. Neighbors had a factor loading of .807 despite the fact that it was ranked seventh among items (Table 41). The high alpha results among factors justified the response consistency among farm operators. The three factors were then subjected to further analysis. The results of analysis of variance of factors by age, years of formal education, income, and number of years in operation of farmers are presented in Tables 43, 44, 45, and 46.

Table 42. Factor loadings of groupings of marketing outlets

Factor grouping	Loading
Factor One--Local Outlet	
Neighbors	.807
Local food stores	.745
Private individual	.708
Feed companies	.671
Customer at home	.666
Roadside	.603
Factor Two--Cooperatives	
Farmers' cooperatives	.771
Grain elevators	.644
Factor Three--Other Agencies	
Agribusiness companies	.795
Government agencies	.695

Table 43 contains the means, standard deviations, F-values, and F-probabilities of marketing outlet factors by the age of farm operators. Again, the use of corporations (Factor Two) had higher mean scores. Farm operators between the ages of 27 and 40 had the highest mean score of 4.32. It was interesting to notice a drop in mean scores among operators between the ages of 41 and 59. There was also a trend toward lower mean values for the use of local outlets. Significant differences occurred among means for Factors Two and Three. A Scheffé post-hoc analysis detected that the significant differences for Factor Two existed between

Table 43. Means, standard deviations, F-values and F-probabilities of factors relating to marketing outlets by the age of operators

Factor		Age of operator			Total	F-value	F-probability
		27-40	41-59	60-78			
Local		n=45	n=71	n=59	N=175		
(Factor One)	M[a]	2.08	1.88	1.93	1.95	.99	.3709
	SD[b]	.62	.74	.81	.74		
Corporations		n=46	n=72	n=62	N=180		
(Factor Two)		4.32	3.86	4.19	4.09	4.75	.0098
		.63	.96	.78	.85		
Other Agencies		n=45	n=72	n=60	N=177		
(Factor Three)		2.92	2.65	2.01	2.50	14.42	.0000
		.98	.94	.82	.98		
Overall mean		3.10	2.79	2.71	2.85		

[a]M = Mean.
[b]SD = Standard deviation.

Table 44. Group means, standard deviations, F-values and F-probabilities for factors relating to market outlet according to years of education

Factor		Years of education			Total	F-value	F-probability
		8-11	12	13-27			
Local		n=20	n=84	n=74	N=178		
(Factor One)	M[a]	2.36	1.81	2.06	1.97	5.39	.0054
	SD[b]	.88	.68	.74	.75		
Corporations		n=20	n=87	n=76	N=183		
(Factor Two)		3.95	4.15	4.04	4.08	.78	.5622
		.98	.83	.89	.87		
Other Agencies		n=20	n=86	n=74	N=180		
(Factor Three)		2.23	2.51	2.58	2.50	1.04	.3550
		.89	.98	.98	.97		
Overall mean		2.85	2.82	2.89	2.85		

[a]M = Mean.
[b]SD = Standard deviation.

operators between the ages of 27 to 40 and those between the ages of 41 to 59. It was observed that significant differences among means for Factor Three were between operators between the ages of 27 and 40 and 60 and 78 as well as between the ages of 41 to 59 and 60 to 78. The mean of the means was observed to be 2.85. Farm operators within the ages of 27 to 40 had an overall mean of 3.10. Table 44 contains the results of analysis by years of formal education of farmers. A significant difference beyond .05 alpha was observed for Factor One. The post-hoc test indicated that a significant difference existed between farmers with 8 to 11 years of formal education and those with 12 years of education with a mean of 2.36 and 1.81 and standard deviations of .88 and .68, respectively.

Farm operators with 12 years of formal education had the highest mean of 4.15 for Factor Two although the general mean scores were fairly high for that factor grouping. The use of other agencies had a higher mean score among farmers with over 12 years of formal education. It was noted that as the mean scores for Factor Three increased, years of formal education increased. It was also noted that operators with a higher number of years of formal education had the highest mean of means of 2.89.

Table 45 reports the data results of marketing outlets by the income of farmers. The higher mean scores among different economic groups for

Table 45. Means, standard deviations, F-values and F-probabilities of marketing outlet by income

Factor		Income: $20,000 or less	$20,001 to $30,000	$30,001 to $40,000	$40,000 or more	Total	F-value	F-probability
Local		n=43	n=48	n=29	n=47	N=167		
(Factor One)	M[a]	2.05	2.06	1.84	1.84	1.96	1.17	.3226
	SD[b]	.74	.88	.58	.72	.76		
Corporations		n=45	n=50	n=29	n=47	N=171		
(Factor Two)		4.04	4.03	4.19	4.09	4.08	.23	.8760
		.79	.94	.83	.94	.88		
Other Agencies		n=45	n=48	n=30	n=46	N=169		
(Factor Three)		2.59	2.72	2.32	2.46	2.54	1.20	.3109
		.90	.94	1.12	.99	.98		
Overall mean		2.89	2.94	2.78	2.79	2.86		

[a]M = Mean.
[b]SD = Standard deviation.

Factor Two consolidated the findings expressed in the above tables. Again, farmers within the annual incomes of from \$30,001 to \$40,000 had the highest mean score of 4.19 for Factor Two (Corporations). The use of local outlets had a slightly higher mean score among farmers with annual incomes of \$20,000 or less and that this economic group had the second highest mean of means of 2.89 after those with annual incomes between \$20,001 and \$30,000.

Means, standard deviations, F-values and F-probabilities of marketing outlet factors by year of operation are presented in Table 46. The use of Corporation had very high ratings among groups especially for Factor Two. Farmers with 40 to 56 years of operation had the highest

Table 46. Group means, standard deviations, F-values and F-probabilities for factors relating to market outlet by number of years in operation

Factor		Years of operation				Total	F-value	F-probability
		1-15	16-29	30-39	40-56			
Local		n=56	n=42	n=38	n=39	N=175		
(Factor One)	M[a]	2.04	2.09	1.74	1.86	1.95	2.12	.0994
	SD[b]	.71	.77	.69	.74	.73		
Corporations		n=58	n=41	n=39	n=42	N=182		
(Factor Two)		4.12	4.08	3.98	4.17	4.09	.33	.8072
		.81	.88	.86	.86	.85		
Other Agencies		n=57	n=41	n=39	n=40	N=171		
(Factor Three)		2.74	2.44	2.64	2.09	2.50	3.95	.0093
		.99	1.01	.95	.88	.98		
Overall mean		2.97	2.87	2.79	2.71	2.85		

[a]M = Mean.
[b]SD = Standard deviation.

mean score of 4.17 for Factor Two. Equally high means were observed for the use of Corporations by farmers with 1 to 15 years of farming experience. Significant differences were observed for Factor Three. The post-hoc test indicated that significant differences beyond .05 alpha occurred between farmers with 1 to 15 years of farming experience and those with 40 to 56 years of experience.

Major Findings

The major findings of this study are:

1. Most of the respondents (69 percent) were full-time farmers, 75 percent owned their farms, and only 18.5 percent had part-time jobs.
2. A majority of respondents had completed 12 years of formal education, while over 41 percent had completed more than 12 years of formal education.
3. Approximately 24.5 percent of the respondents reported an annual income of $20,000 or less, whereas 27.2 percent reported income between $20,001 and $30,000 per annum.
4. Majority of farmers had been in operation for over 15 years with a mean of over 26 years.
5. Feed and fertilizer had the highest farm resources allocated to them.
6. Analysis of farming systems research and development items indicated that:
   a. Farmers should have more say in shaping agricultural policy which affects their operation.
   b. Increasing the size of farms to maximize profit was rated low.

c. Farm research with farmers' participation was rated highly.

d. Farmers are capable of making valid decisions if information about their operation is made available to them.

e. Research, efficient and sustainable agricultural system, on-farm trials, livestock integration, and education were the highlights of farming systems research and development.

f. Corn and soybeans were the two most important crops grown, while hogs and beef cattle were the two widely produced types of livestock.

g. Some farmers' operations had both crops and livestock, hence the greater allocation of resources to feed.

h. Both conventional and farming system research are required to solve farm problems.

7. Analytical results from farming systems factors indicated that:

a. Problem solving and market information were highly rated.

b. Significant differences occurred between farmers with 8-11 years of formal education and those with 12 years of formal education.

c. On-farm trial was rated high by farmers between the ages of 16 and 29.

d. Agricultural Protection was rated low by farmers with 1 to 15 years of farming experience and by all farmers, irrespective of economic group.

8. The present order of importance of the existing educational subject matter centered around farm safety, record keeping, financial management, soil conservation, and agricultural marketing.

9. The future order of importance of educational subject matter was record keeping, soil conservation, financial management, and farm safety.

10. Farmers obtain farming information from many sources, especially through radio, magazine, newsletter, agricultural shows and meetings.

11. The influence of public and private agencies in the decision making among farm operators relies more on which agencies they were identified with.

12. College/university researchers as well as the Agricultural Extension Service influence farmers' decisions.

13. Descriptive analysis of educational factors revealed that:

    a. No significant difference existed between different economic groupings in their perception of subject matter group factors.

    b. Natural resources had received the highest means of 4.03 among $40,000 and above income group.

    c. Technology had the lowest mean rating among the low income grouping.

    d. The importance of livestock in the future was generally expressed with a mean of 4.04.

14. Most farm operators used Farmers' Cooperatives and Grain Elevators to market their products.

15. Sales and services had the lowest mean score among operators with less than 12 years of formal education.

16. Educational status was vital in determining the sources of

agricultural information available to the farmer.

17. Pricing of agricultural products, International Market System, Agribusiness/Multi-Corporation, Different Agricultural Programs, and Government Agricultural Policy were the top five constraints faced by farmers.

18. Location of the farm was not perceived as a major constraint in farmers' agricultural enterprises.

19. Limited research information was perceived as a major constraint among farmers between 60 to 78 years of age.

20. There was a significant difference between farmers with 8 to 11 years of education and those with 13 to 27 years in terms of how research information is obtained as well as between those with 12 years of formal education and those with 13 to 27 years of formal education.

21. Increase in number of years of formal education had positive influence on how financial constraints were perceived.

22. Farmers with high incomes tended to use Corporations and Farmers' Cooperatives as their major marketing outlet.

DISCUSSION

The major purpose of this study has been established. It was designed to: (1) determine farmers' perceptions on ways to improve the existing farming systems in Iowa and how best the livestock enterprise could be incorporated into the existing system; (2) identify farming systems educational program areas, sources of farming information, and the extent of cooperation between farmers and public agencies; (3) identify the deficiencies and constraints of the existing farming systems as perceived by farmers with implications for agricultural education. The instrument used in the study was designed to accomplish the above stated objectives (Appendix A). The results of the analysis from the data indicated that the instrument design was appropriate for the study. With the exception of the resource allocation aspect of the questionnaire, the respondents seemed knowledgeable about issues studied. The major setback in this study was finances, which limited the scope of this study. The timing of the study was inadequate as the questionnaire was mailed at the beginning of the winter season. Many of the respondents reported having been out of business, while a greater number of them had moved from their location. A few of the respondents tampered with instrument identification numbers, thereby rendering them unusable. However, the study was conducted in conformity with the existing outline guiding farming systems research and development projects (Norman, 1980; Garrett, 1982; Hildebrand, 1986). The use of a questionnaire in this type of study was also supported in the literature.

The population for this study was farm operators in Story and Boone Counties of Iowa. The post-hoc reliability of sectional items was established using the Cronbach alpha test which ranged from .6468 to .9092 as shown in Table 3. The lower alpha level for Market Outlet may be attributed to the size of the section in the questionnaire. The result of the reliability test inferred that the issues responded about were issues with which farmers were familiar. It also gave more insight to the analytical results presented in the preceding chapter.

The first part of the instrument was designed to address the first objective of the study. The analytical results were presented in Tables 5 to 11. Before interpreting the results of the analysis, the characteristics of the respondents in Table 4 need to be addressed. Table 4 established that most farm operators were males. That disparity in age that existed among farmers was a fact, but the majority of farmers were between the age of 41 and 59 with an average age of 52 years. Most farm operators were married and maintained farming as a family business. Most of them were farm owners and full-time farmers. A sizeable number of them, 39.70 percent, utilized family labor in their enterprise (Deseran et al., 1984). Almost 50 percent of respondents had 12 years of college education.

About 51.7 percent of the operators fell within income range of $20,000 and $30,000. The analytical result presented in Table 4 helped to draw the conclusion that 54.3 percent had been in operation for less than 29 years. It could be concluded that feed consumes a greater amount of resource allocation. Having established these facts about the characteristics of the respondents of the study, the issues pertaining to the first objective of the study using the information available will be addressed.

Information was sorted on farming system issues and respondents were asked to respond to what extent they agreed with each statement. The data collected were analyzed and results tabulated as shown in Table 5. In general, the respondents agreed that farmers or farm operators should have more say concerning agricultural policies which affect them (mean = 3.32). The idea to promote agricultural systems which are efficient and sustainable was also supported by farmers. The central objectives behind farming systems research and development were upheld by the respondents in the study. At this juncture, we may point out that although the means were generally low in this section of the study, the top ten items had means above the 3.00 point level. These included the ability of farm operator to make valid "decisions on farm issues if enough information is made available to them." It could also be concluded that farmers supported the "integration of livestock into the farming system" with the idea of improving the soil condition and to cut down on the "quantity of commercial fertilizer used on Iowa farms." These two points tend to agree with the movement of regenerative agriculture, organic farming, and sustainable agriculture. Another area generally agreed to by respondents was in the area of research. Farming systems research and development principles are advocated for such as farmer/researcher cooperation (Norman, 1980; Plucknett, 1982; Bernsten et al., 1984). A valid conclusion could be drawn based on the response mean of the respondents that "farm research conducted with farmers' participation is more beneficial than such research conducted by researchers alone." They also supported the on-farm trial method when they agreed that "agricultural research conducted by universities and experimental stations should be tried in farmers' fields." The respondents agreed that this type of research "would facilitate decisions about new agricultural innovations." Requiring "both conventional and farming systems research to solve the present farm problem" was marginally agreed on with a mean of 2.98 as well as the idea of "interdisciplinary approach to farming systems problems." The respondents disagreed that "increasing the size of farming operation" is necessary for maximization of profit. Equally disagreed on was that "merging or combining farm operations with other producers ensures for marginal profit." Farmers disagreed about providing subsidy and protection. Farm operators agreed that "pushing small-scale farmers" out of business will hurt the American economy and that "consumers will suffer the impact of eliminating small-scale operators." With the mean of 3.11, the operators agreed that "agricultural educators need to promote efficient, sustainable, and profitable agricultural systems."

There was marginal agreement among farmers that agricultural educators should educate farmers on subject matter relevant to their enterprises. The general concept espoused was greater involvement of farmers in policy making and the research process as well as promoting efficient and sustainable agricultural systems. Totally rejected was the idea of eliminating small-scale farmers, the promotion of subsidy, and merging of farming operations together. Increasing the size of farming operation was also rejected, thereby defeating the "get big or get out" theory. The idea that the introduction of livestock to the farm will promote even distribution of income and resource received marginal agreement from farmers. To further put the responses into perspective, the factor analysis tried to group related items into clusters and the factor groupings were assigned names. The alpha loadings of the factors clearly substantiated the stand of the farmers on farming systems research and development issues. All factor loadings satisfied the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and in this case compared the magnitude of the observed correlation coefficients to the magnitudes of the partial correlation coefficients. This test was further consolidated with the Bartlett's test of sphericity which tested the hypothesis that the correlation matrix of items was identity matrix. After satisfying these tests, the alpha levels of items within the factors tended to reflect the earlier point we have illustrated. Notice that Factor One (Small-scale Agriculture) had two outstanding items with loadings of .797 and .777 which substantiated that eliminating small-scale farmers was not a good idea with due respect to the national economy. The second item with .777 alpha related to the first item about the consequences of such events on consumers.

Factor Two (Crop/Livestock Integration) received relatively high alpha loadings, but the highest alpha loadings were observed in Factor Three (Problem Solving). Two items within the factor grouping received alpha levels of .844 and .809 all centered on research and these two items supported the farmer/researcher partnership as a viable solution to agricultural problems. Factor loadings in Factor Three stressed and supported the earlier proposition about research conducted in farmer's field, having the highest alpha loading. The need for making marketing information available to the operators was stressed in Factor Six. "Farmers need more marketing information to stay in business" had an alpha level of .744. It was necessary at this juncture to observe that increasing the size of operation received a negative alpha level of minus .556, which equally stressed the stand taken by operators that increasing the size of farming operation does not necessarily maximize profit. The concepts attached to factors was used to conduct further analysis to determine if differences occurred within and between factors as well as between different categories of operators in terms of age, annual income, number of years in operation, and number of years of college education.

The results of the findings indicated that there was no significant difference among operators in terms of the number of years of college education except for Factor Three (Problem Solving). A post-hoc test (Scheffé) indicated significant differences between farm operators who had less than 12 years of education and those who had 12 years of education, as well as those with more than 12 years of education. Justifiably those with more than 12 years of education may have more access to research information and may have been exposed to research findings through interaction with higher institutions and other corporate bodies.

There was no significant difference among farm operators with regard to the number of years in operation. However, mean differences existed between means. That marketing information received a fairly uniform mean rating in Factor Six (Market Information) clearly suggested that marketing information was essential irrespective of operators' number of years in operation.

There were no significant differences among income groups when compared by factors. However, mean differences existed between and within factors (Table 10). Farmers with incomes of $40,000 or more tended to need more marketing information, hence the highest mean rating of 3.15.

According to the findings, there were no significant differences among operators by age although mean differences occurred within and between factors and between farm operator categories. Using mean difference as one criterion, it seemed that younger operators between the ages of 27 and 40 recognized the usefulness of research in their enterprise with a mean of 3.17 in Factor Three (Problem Solving) compared to older operators between the ages of 60 and 78. The research outcome indicated that farmers were supportive of farm research and such research would help them make useful decisions about their farming operations. The information in Table 6 indicated that the substance for on-farm research exists in the present farming system in Iowa--corn and soybean being the most widely grown crops while hog and beef cattle were the most widely grown livestock. As indicated by the results of the analysis of the data, one could conclude that farm operators were supportive of farming systems research in terms of greater involvement of farmers. It also provided an opportunity for agricultural educators to promote efficiency and sustainability in agricultural enterprises.

This conclusion led to the second objective of this study which was to identify farming systems educational program areas, sources of information, and the extent of cooperation between the farmers and public agencies. The second objective was designed to identify the importance of educational program needs of the present existing system and the importance of those programs in the future. The issue of information source was considered at this juncture as well as who should shoulder the responsibility of disseminating research information among private and public agencies. Certain sections of the instrument were designed to collect enough data for this purpose (Appendix A). Respondents were asked to respond to listed items using direction and the scale for that section. The subjected matter section was responded to on a scale of 1-5: 5 = Utmost Importance; 4 = Much Importance; 3 = Average Importance; 2 = Little Importance; and 1 = Least Importance. The section of information sources was responded to on a scale of 1-5: 5 = Very Important; 4 = Important; 3 = Moderately Important; 2 = Less Important; and 1 = Not Important at All. In the same token, the section on which agencies influence the farmers' decision-making process was responded to on a scale of 1-5: 5 = Very High; 4 = High; 3 = Moderate; 2 = Low; and 1 = Very Low. Five items--"Farm Safety, Record Keeping, Financial Management, Soil Conservation and Agricultural Marketing (listed according to decreasing order of their magnitude)--were considered of "much importance" to farm operators at present. Other items were moderately important with the exception of Forest Management and Computer Data Analysis, which were considered to be of "little importance" to the present farming system, having the means of 2.65 and 2.86, respectively. For the future importance of the same items, the respondents considered nine items to be of much importance. The items listed, according to their order of importance, were record keeping, soil conservation, financial management, agricultural marketing, farm safety, environmental control, economics of production, pest management, and machine maintenance. Every other item was considered to command average importance in the future except forest management, which was considered being of little importance in the future. Farm safety dropped to number two ranking, while record keeping rose to number one for the future. Horticulture was ranked 21 out of 21, both now and in the future. The outcome of this section draws the attention of agricultural agents, researchers and policy makers as to what program to keep or encourage at the moment and which programs should be planned for the future. The subject matter results call for educators to re-examine existing programs in terms of the existing farming systems as well as the importance of those programs in the emerging agricultural systems.

Table 13 revealed the sources of information which are vital for maintaining a sustainable and efficient agricultural systems. Radio, magazine, newsletter, agricultural shows, meetings, bulletins, demonstrations and workshops were the top ranked sources of information available to the respondents in the study. The least was the use of state fair, with a mean of 3.03, as an information source.

The level of influence on the decision making of farm operators by public and private agencies was included to achieve the desired objectives. The findings in Table 13 indicated that the Agricultural Stabilization Service (ASS) had a moderate influence on operator involved in this study. The result in this section was highly influenced by the choice of population. The sample for the study was drawn from the list provided by the ASS. Other public agencies included: Farmers' Cooperatives; Agricultural Research Service; Agricultural Extension Service (AES); College/university researchers and agribusiness companies. Farmers' Home Administration least influenced farmers' decisions, followed by Iowa Department of Commerce.

The responses were again subjected to KMO sampling adequacy and Bartlett test of sphericity before being analyzed for factor loadings. Tables 15, 16, 17, and 18 contain the results of the factor analysis. Table 15 revealed the findings of the present importance of subject matter. It was surprising that computer data analysis had a very high loading of .837 alpha as a factor even though it was not considered as being important in Table 12. Factor Three (Natural Resources) had very high loading alpha of .819 for Environmental Control and .813 for Soil Conservation. The high alpha level of Factor Five (Livestock Production) could be interpreted as the respondents' support for integrated farming system.

Table 16 contains the factor loadings for the present importance of listed subject matter. Again, Disease Prevention came out with a very high alpha of .876, followed by Forest Management with .807, all narrowing down to farmers' perceptions about farming systems research and development. In Table 17, the information sources highly loaded included workshop, .800; Bulletin, .856; and Newsletter, .824. In Table 18, the grouping of factors according to their level of influence on farmers was presented. Here the Agricultural Research Service and Agricultural Experiment Station had very high alpha loadings, while Farmers' Cooperatives scored .813. Generally, all factors had alpha loadings way above the acceptable limit, which emphasized the feasibility of crop/livestock integrated systems. The factor groupings were subjected to analysis of variance to determine if response differences exist among the recoded independent variables by income, age, years of education, and years in operation. The results were presented in Table 19-34 for all sections and factors generated.

Table 19 contains the results of analysis of the present importance of subject matter as perceived by the respondents by income of operators. There were no significant differences between economic categories. However, the mean differences did shed light to substantiate what has been said. All the factors were fairly rated, but the mean for the farm operator within the income range of $40,000 or more conveyed the message of much importance attached to natural resources in the existing farming system. The mean of means of 3.55 indicated that, in the main, the components of these factors play an important role in the sustainability of the present farming systems. The above average importance accorded to most of the items confidently sanctioned crop/livestock enterprise including the management aspect of it and the technology therein as a part of farming systems.

Table 20 contains results of analysis on the future importance of subject matter in the existing farming systems by income of the respondents. The general outlook among these factor means was interesting. Sales and service would be one of the most important items in the future. The significant differences between respondents of different economic groupings existed for Factor Five (Crop Production). Farm operators with incomes above $40,000 or more did not support the proposition that crop production in future would be an issue. On the other hand, farmers with annual incomes of $20,000 or less had different opinions. The general trend between these two economic categories support the notion that farming systems research should be planned for the lower income groups.

Table 21 and 22 contain information pertaining to information source and decision making factors by income of the operators. There were no significant differences between the response of economic categories as shown in the two tables. All factor means indicated that these factors were moderately important to farm operators. On the other hand, the influence exerted by government establishments among farm operators was low.

The present and future importance of subject matter by years of education were presented in Tables 23 and 24. There were no significant differences among operators of different educational level. The general mean trend supported the argument that these factors were of more than average importance. Significant differences occurred between farmers of less than 12 years of education and those with more than 12 years of education and between those with 12 years of education and with those with more than 12 years of education in their use of News Media. Farmers with less than 12 years of education tend to use News Media as source of information. Looking at this trend, one may conclude that the use of News Media as a source of information for the respondents in this study decreases with increases in years of education. The mean differences also suggested that farmers with less than 12 years of education use less printed matter but more visuals and participatory techniques to obtain farming information.

There was no significant difference among respondents on factor loadings by years of education of farmers as shown. Those respondents with more than 12 years of education tended to be influenced by the corporations with a mean of 3.35 as opposed to those with less than 12 years of education or 12 years of education with means of 3.25 and 3.28, respectively.

Tables 27 and 28 dealt with the present and future importance of subject matter by year of operation. There were no significant differences among operator categories with regard to their perceptions about the present importance of subject matter for the factors studied. However, Table 28 indicated significant differences between operators with 1-15 years of farming experience and those with 30-39 years for the Technology factor. This difference may be attributed to the age and educational level of respondents. The younger generation of farmers tends to have access to modern technology and may associate more with industries and institutions where new technologies were born. Another interpretation for the difference may be that operators with many years of experience may be conservative and want things to stay the way they are or that the cost of changing from old to new may not be cost effective. The reader needs to be aware of the high importance attached to natural resources by all categories of operators while other factors were of average importance in the future.

There were no significant differences among respondents as far as information source and influence on decision making by years of operation. Again, there was no significant difference among operators with regard to the present importance of subject matter by age of operators among factors. Significant differences occurred between operators within the age of 27 and 40, and those between 60 and 78. Again, this difference could be due to exposure to modern technology by the younger generation of farmers. The components of this factor may not be appealing to the older farmers, especially in the area of biotechnology and computer data analysis. Once more, it would not be cost effective for an older farmer to invest in modern technology. The level of education may equally create response differences as most elderly farmers would not want to become knowledgeable about modern technology.

The last two tables were concerned with the information source factors by age of the respondents. There were no significant differences among respondents in terms of their years of experience as far as decision-making process as influenced by agencies was concerned.

However, significant differences were observed between operators within the age of 60 and 78 and those within 27 and 40 for Factor Two (News Media). The elderly farmers tend more to use the radio, television and newspaper (probably community newspapers) to obtain information while well-educated and younger farmers tend to use more printed matter. The difference could also be attributed to mobility and available opportunities for younger farmers and their identifying themselves with colleges and universities and with researchers in both public and private sectors. The younger farmers may obtain most of their information through the mail and may have part-time job which delimits the amount of time spent on television and radio. Based on these observations, one could conclude that the second objective of this study was met.

The educational areas for the present and the future were identified, sources of information and the extent of usage in the existing systems were identified, and who influences the daily farming decision of the operators were established. It would be in the interest of farming systems researchers to take notice of these facts when planning agricultural educators and policy makers need to consider these issues when planning future programs.

The third objective of this study was to identify the deficiencies and constraints of the existing farming systems as perceived by farmers with implication for agricultural education. In pursuit of this objective, the instrument was designed to collect further information on certain constraint issues and to weigh deficiencies in line of marketing outlets. Tables 35 to 46 contain the results of analysis of the data collected. In Table 35, the five major constraints identified were pricing method of agricultural products; government agricultural policy; international market system; agribusiness/multi-corporations; and different agricultural programs.

The location of the farm and information system system were the least among the constraint items. When the items were subjected to factor analysis, three factors were generated--Factor One (External Constraint); Factor Two (Research Information); and Factor Three (Financial Constraint). The higher alpha levels indicated that government agricultural policy and research methodologies received the highest alpha loadings of .823 and .800, respectively. The factors were again subjected to further analysis by age, years of education, income, and years of operation. The result of analysis of variance indicated significant differences between operators within the ages of 41 and 59 and those of 60 and above for Factor Two--Research Information. This observation contributed to strengthening the conclusion that younger farmers tend to obtain research information probably because of their high interaction with research institutions and close relationship with their peers. Younger farmers may have part-time jobs which allow them greater mobility. We may have to add that older farmers may have a look-warm attitude toward research findings; hence, research information becomes a hindrance to their farming operation. Again, the mention of research methodology as one of the constraint established the necessity for on-farm research which was established in the first objective of this study. It also supports the idea of greater involvement of farmers in research process and in policy making.

The response of farmers by income indicated that there were no significant differences between income groups. Data in Table 39 indicated significant differences among operators according to their years of education for Factor Two (Research Information) and Factor Three (Financial Constraint). The results presented illustrated that farmers with less than 12 years of education had limited access to research information which has been earlier established. Farmers with more than 12 years of education experienced less financial stress than did those with 12 years of education or less. One could then draw the conclusion that the major constraints in the present farming system in Iowa are research information and lack of money. The reader needs to be reminded that farmers had earlier indicated that financial backing should rule out subsidy which was established in the first objective.

Further analysis by year of operation yielded no significant differences among respondent groups. The high mean rating for Factor One (External Constraint) suggests that farmers recognized that external constraints have more than a moderate effect on their enterprise. Grain Elevators and Farmers cooperatives were the most likely outlets used by farmers to market their products. Least used marketing outlets were roadside sales and local food stores. The unlikelihood of using local food stores may affect the efficiency of existing farming system. The items were subjected to factor analysis. Using neighbors as marketing outlet had an alpha level of .807 followed by local food stores (.745) and private individual (.708). Further analysis of data by age, years of operation, income and years of education revealed no significant differences except for marketing outlet by age of operators. Farmers 27 to 40 years of age were most likely to use farmers' cooperative and grain elevators. Those within 41 to 59 years of experience used these cooperative bodies. The use by these younger operators of these two marketing outlets may be attributed to greater interaction between younger farmers and these grain elevators. The use of other agencies was significant at .01 alpha strongly suggested that younger farmers use other agencies to market their farm products. Younger farmers may also use these companies for security purposes and to insure success. On the other hand, older farmers may tend to use other marketing outlets not mentioned in the list.

Analyzing marketing outlet data by education indicated a significant difference existed among respondents for Factor One (Local). Here again, the means were much lower in value. This observation may suggest that farmers use multiple outlets to market their agricultural products. There was no significant difference when income of operators was compared by factor. A significant difference existed between farmers with different years of education on the use of other agencies. It could be concluded that younger farmers tended to use other agencies as opposed to older farmers who have been in farming for over 40 years. The ability to move about should be considered as one of the factors.

SUMMARY AND IMPLICATIONS

The established purpose of this research was to determine the relevant educational program needs of the existing farming systems in Iowa, identify ways of improving them, and provide information as to farmers' perceptions about conducting farming systems research on integrated crop and livestock enterprises. The three specific objectives of the study were to: (1) determine farmers' perceptions on ways to improve the existing farming systems and how best livestock enterprise could be incorporated into the existing system; (2) identify farming systems educational program areas, sources of farming information, and the extent of cooperation between farmers and public agencies; and (3) identify the deficiencies and constraints of the existing farming systems as perceived by farmers with implications for agricultural education. The population for this study included farm operators in Boone and Story Counties of Iowa who were in the 1987/88 program register of Agricultural Stabilization Service (ASS). The major problem of using this data list was location of farm operators. Out of 1878 operators listed, 308 farmers were selected as the actual sample, and 70 farmers were selected as substitutes for the original sample. Analysis of data began with a response rate of 57.79 percent from Story County and 60.01 from Boone County. The questionnaire was designed based on information gathered from the literature. The content validity of the instrument was tested and approval to use the instrument was obtained from the Committee on the Use of Human Subjects in Research at Iowa State University. The reliability of the instrument was determined using the Cronbach's alpha sub-program reliability procedure. Data were analyzed using the central tendency procedure (means, standard deviations, and median), as well as one-way analysis of variance tests. Factor analysis of the data was conducted after testing the appropriateness using the Bartlett's test of sphericity and Kaiser-Meyer-Olkin (KMO) test of sampling adequacy. Factors of each section were analyzed using one-way analysis of variance and findings reported according to stated objectives to test if significant differences existed among different categories of operators by age, income, years of education, and years in operation.

Findings revealed that out of 30 generated items related to farming systems research and development, the top ten were centered on the concepts of farming systems research--participation, research (methodology), education, decision making, and information. Farm operators agreed that "farmers or farm operators should have more say" on agricultural policy issues. Among the major emphasis was the need for efficient and sustainable agricultural systems through farmers' participation in research, on-farm trial of research innovation.

Equally manifested in the findings was that farmers are capable of making decisions if adequate information is made available to them. The idea of using subsidy programs was not considered important by the operators involved in the study. It was also agreed that eliminating the small-scale farm operator would hurt the national economy.

The idea of integrated systems was accepted by the respondents and considering the amount of resources allocated to feed, one may conclude that the existing structure is ripe for crop and animal research to form an integrated system. Farmers marginally agreed that diversification is the answer to the solution of the present farm situation, but disagreed that increase in the size of operation is necessary to maximize profit. The summary of this section was based on the response rate of the top ten items and the analytical results which followed.

Findings supported diversified agricultural systems especially in crop and livestock production. About 176 out of 184 (95.7 percent) farmers grew corn, whereas 161 out of 184 (87.5 percent) grew soybeans. In the area of livestock production, 74 out of 184 (40.2 percent) raised hogs, while 65 out of 184 (35.3 percent) raised beef cattle. The statistics presented supported the demand for disease prevention which may allow one to conclude that operators were demanding increased research on livestock production. One-way analysis results indicated significant differences in Problem Solving by years of education.

Objective two of this study was to identify educational program areas, sources of information, and extent of influence agencies have on farmers' decision making. The ten most important subjects to the farmers at the present were farm safety and record keeping. However, when the same list of subjects were weighed on their future importance, "record keeping" emerged at the top of the list followed by "soil conservation." "Horticulture" and "forest management" were least important subjects for the future.

In the area of information sources, radio, magazines and newsletters were the top sources which may suggest that most people engaged in farming operation were educated. Considering the position of the television in the findings, one questions the present trend of using television as an information medium for farmers. Further analysis of data revealed significant differences among operators by income, education, years in operation, and age. These differences may suggest that different programs be planned for different groups of farmers which, when utilized, would help group farmers into recommendation domains (Tripp, 1986).

As to which of the public agencies most influenced the decision of operators, the Agricultural Stabilization Service topped the list followed by farmers' cooperatives. The emergence of ASS may be misleading considering the population of the study. However, the Agricultural Extension Service and College and Universities emerged fourth and fifth, respectively, and may play vital roles in research and information dissemination to farmers.

The last objective was to determine the constraints in the present agricultural systems. "Pricing method of agricultural products" was recognized as the number one constraint followed by "government agricultural policy" and "international marketing system." One may conclude that constraints posed by pricing method of agricultural products may be magnified by lack of cooperation between the farmers and the Department of Commerce. Analysis of the factors indicated significant differences among operators in terms of age (research information), and education (research information and finance).

Findings reveal that operators use multiple outlets to market their products. The major outlets, according to this study, were grain elevators and farmers' cooperatives. Further analysis indicated that significant differences existed between the use of marketing outlets in terms of years of education, age, and years in operation. The results from this study suggest that research and research information should be made available to farmers and that such research involve farmers. It also suggested that policy makers should involve farm operators on issues relating to agricultural production. Program planners need to consider the age and educational levels of farm operators in their planning.

Implications, Recommendations, and Research Orientation

The implications for findings include:

1. Public and private agencies need to promote farmers' participation on policy issues relating to agricultural productivity.
2. Research organizations should encourage farmers' participation and make on-farm trial of research results their number one priority.
3. Agricultural educators need to examine the subject matter area and include them in their program.
4. Curriculum developers need to consider that subject matter with greater potential of preparing students for a profitable career in agriculture.
5. Researchers need to prepare research information to reach different audiences through the use of different medium of

instruction.

6. Expanding market opportunities for agricultural products should be the major objective for an efficient and sustainable agricultural system in Iowa.

Direction for further research

Further research is needed to determine how best to involve farmers in agronomic research as well as policy and decision making.

More research is needed to determine the effectiveness of using the information medium in sending different messages to different categories of farmers.

The role of each component part of existing farming systems needs to be determined by future research.

On-farm research needs to be conducted to identify the economic feasibility of farming systems research and development in different geographical areas.

Recommendations

The findings revealed that deficiencies in research methodology and dissemination of research information still plague farmers involved in this study despite their proximity to Iowa State University where most research findings are born. Results revealed that pricing of agricultural products and international marketing systems were the major constraints. The question is whether these problems could be avoided. The answer is yes if some or part of these recommendations are put into practice.

1. Farmers should produce for local consumption.
2. Diversification in crop and animal production should be the rule rather than the exception among farm operators.
3. Farmers need to improve their relationship with government and private agencies to enhance price adjustment and to promote efficiency in their agricultural enterprises.
4. Researchers need to work closely with farmers to maintain a stable and viable agricultural economy.
5. Maintaining small producers should be encouraged at all levels of agricultural production.

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APPENDIX A. QUESTIONNAIRE AND CORRESPONDENCE

Iowa State University of Science and Technology Ames, Iowa 50011

Department of Agricultural Education
201 Curtiss Hall
Telephone: 515-294-5872

Dear Farmer,

Farming systems research and development (FSR&D) recently emerged as a new research approach in which the farmer or farm operator works in partnership with a group of agricultural scientists. This approach, unlike the conventional research approach, has shown greater potential. It encourages conducting a research on farmer's fields based on the needs and aspirations of his/her household.

The need for this study is real as a substantial number of farms in Iowa face financial stress. Other farm problems include the decline in the average value of farmland; the farm foreclosures, and low farm commodity prices throughout the entire central region.

This study is designed to:

a)__identify the problems in the existing farming systems in Iowa;
b)__encourage crop and livestock integration in Iowa farms;
c)__determine possible solutions to the present farm situation; and
d)__propose an alternative educational needs of the present and diversified farming systems in Story and Boone counties of Iowa

You are one of the 500 farmers selected to participate in the study. Your response is vital and contributes to the success of the study. Please carefully complete the enclosed study questionnaire.

Please note that your responses are strictly confidential. Group data will be analyzed without associating responses with individuals.
Please return the questionnaire within the next two weeks. Staple or tape the open end of the questionnaire and drop it in the Post Office mail box.

Your contribution is appreciated.

Thank you

Dr. Alan A. Kahler
Dept. of Agricultural Education
Iowa State University
(515) 294-0894

Fidelis N. Ubadigbo
(Graduate Student)
Iowa State University
(515) 296-0901

EDUCATIONAL IMPLICATIONS FOR INTEGRATED CROP AND LIVESTOCK FARMING SYSTEMS RESEARCH AND DEVELOPMENT (FSR&D) IN IOWA

PART ONE

DIRECTIONS:

Please read the following statements and indicate your level of agreement by circling the appropriate number. Use the scale of 1-4 below as follows:

1.....STRONGLY DISAGREE
2.....DISAGREE
3.....AGREE
4.....STRONGLY AGREE

Section (A)

"Farming Systems Research and Development (FSR&D).

EXAMPLE: Agriculture is important in the U.S. economy......1 2 3 4

1. Farm operators working in partnership with researchers is necessary in solving farm problems....................1 2 3 4

2. Both conventional research and farming systems research are required to solve present farm problems..............1 2 3 4

3. Farm operators need agricultural systems which are efficient and sustainable...............................1 2 3 4

4. The financial and social needs of farm operators have not been met by the present agricultural system in Iowa..1 2 3 4

5. Diversification in agriculture should be a solution toward a sustainable agricultural economy................1 2 3 4

6. Examining the farm operation as a whole may help to identify the major constraints of Iowa farms.............1 2 3 4

7. Present agricultural policy is responsible for the present crisis in Iowa farms............................1 2 3 4

8. Agricultural educators need to promote efficient, sustainable and profitable agricultural systems..........1 2 3 4

9. Farm research conducted in farmers' own fields will facilitate decisions about new agricultural innovations..1 2 3 4

10. Farmers or farm operators should have more say concern-

ing agricultural policies which affect them..............1 2 3 4

11. Increasing the size of farming operation is necessary to maximize profit in any agricultural enterprise........1 2 3 4

12. Merging or combining farm operations with other producers will assure a marginal profit..................1 2 3 4

13. Farmers who raise both crops and livestock profit more than those who raise either crops or livestock...........1 2 3 4

14. Pushing small-scale operators out of business will hurt United States agricultural economy..................1 2 3 4

15. The consumers will suffer the impact of eliminating small-scale farmers....................................1 2 3 4

16. Farm research conducted with farmers participating is more beneficial than ones conducted by researchers alone.1 2 3 4

17. Agricultural research conducted in universities and experiment stations should be tried in farmers' fields...1 2 3 4

18. An interdisciplinary team approach will help to identify the limiting constraints of any agricultural systems.....1 2 3 4

19. Introducing livestock in Iowa farms will increase the net profit from agricultural production..................1 2 3 4

20. Crop and livestock enterprises promote even distribution of labor and resources in the farm..........1 2 3 4

21. Crop and livestock integration ensures an equitable distribution of farm income all year round.....1 2 3 4

22. Specialization in agricultural production has limitations in terms of efficiency and sustainability....1 2 3 4

23. Farming should be regarded and treated as any other business in the United States............................1 2 3 4

24. Agricultural educators should educate farm operators on subject matter relevant to their enterprises..........1 2 3 4

25. The state and federal government should protect farmers from foreign competitors.........................1 2 3 4

26. Farmers need more marketing information to stay in business..1 2 3 4

27. Farm operators are capable of making useful decisions on farm issues if enough information is made available...1 2 3 4

28. Farmers need more subsidies and protection from

lending institutions to stay in business................1 2 3 4

29. Livestock integration on Iowa farms provides organic manure to improve the soil conditions............1 2 3 4

30. The quantity of commercial fertilizer used in Iowa farms will be less if livestock is raised in the farm....1 2 3 4

Section (B): "Crops and Livestock Production"

Directions:

Please place a check mark ( ) on the left side of crops and livestock produced in your farm presently. Use the scale of 1-5 on the right side of items to indicate your level of production. The scale is read as follows:

1. CROPS:

A) ________Corn
B) ________Oats
C) ________Barley
D) ________Wheat
E) ________Soybeans
F) ________Feed grain
G) ________Hay
H) ________Corn silage
I) ________Beans
J) ________Sorghum
K) ________Others

2. LIVESTOCK

A) ________Dairy cow
B) ________Hog
C) ________Beef cattle
D) ________Sheep
E) ________Goat
F) ________Rabbits
G) ________Others

PART TWO

SECTION (A) "CONSTRAINTS" (things that limit your farm operation)

Direction:

To what extent do you regard the following items as being a constraint to your farming operation? Use the scale below to indicate the level of constraint:

5.....VERY HIGH
4.....HIGH
3.....MODERATE
2.....LOW
1.....VERY LOW

1.	Agricultural marketing system..........	1	2	3	4	5
2.	Agricultural credit system.............	1	2	3	4	5
3.	Transportation system..................	1	2	3	4	5
4.	Location of your farm..................	1	2	3	4	5
5.	Information system.....................	1	2	3	4	5
6.	International market system............	1	2	3	4	5
7.	Pricing method of ag. products.........	1	2	3	4	5
8.	Government agricultural policies.......	1	2	3	4	5
9.	Different agricultural programs........	1	2	3	4	5
10.	Agricultural input system..............	1	2	3	4	5
11.	Research methodologies.................	1	2	3	4	5
12.	Agribusiness/multi-corporations........	1	2	3	4	5

SECTION (B) "SUBJECT MATTER"

Direction:

The following agricultural subject matter has been used in programs by various agents to educate farmers in Iowa. How important is each item to you now and how important do you think it will be in the future in your farm operation. Use the scale of 1 to 5 below to indicate the level of importance.

5...Utmost importance
4...Much importance
3...Average importance
2...Little importance
1...Least importance

EXAMPLE: "Poultry keeping".....1 2 3 4 5 1 2 3 4 5

SUBJECT MATTER	"IMPORTANCE NOW"	"IMPORTANCE IN FUTURE"
1. Agricultural marketing.........	1 2 3 4 5	1 2 3 4 5
2. Agriculture mechanics..........	1 2 3 4 5	1 2 3 4 5
3. Horticulture....................	1 2 3 4 5	1 2 3 4 5
4. Agric. sales/services..........	1 2 3 4 5	1 2 3 4 5
5. Agricultural processing........	1 2 3 4 5	1 2 3 4 5
6. Forest management..............	1 2 3 4 5	1 2 3 4 5
7. Soil conservation..............	1 2 3 4 5	1 2 3 4 5
8. Environmental control..........	1 2 3 4 5	1 2 3 4 5
9. Farm safety....................	1 2 3 4 5	1 2 3 4 5
10. Record keeping................	1 2 3 4 5	1 2 3 4 5
11. Pest management...............	1 2 3 4 5	1 2 3 4 5
12. Financial management..........	1 2 3 4 5	1 2 3 4 5
13. Computer Data Analysis........	1 2 3 4 5	1 2 3 4 5
14. Biotechnology.................	1 2 3 4 5	1 2 3 4 5
15. Community Development.........	1 2 3 4 5	1 2 3 4 5
16. New farming technique.........	1 2 3 4 5	1 2 3 4 5

17. Farm Budgeting.................1 2 3 4 5   1 2 3 4 5

18. Livestock production...........1 2 3 4 5   1 2 3 4 5

19. Disease Prevention.............1 2 3 4 5   1 2 3 4 5

20. Machine Maintenance............1 2 3 4 5   1 2 3 4 5

21. Economics of production........1 2 3 4 5   1 2 3 4 5

22. Others ____________............1 2 3 4 5   1 2 3 4 5

PART THREE

SECTION (A) "INFORMATION SOURCES"

Direction:

Information is vital for efficient and sustainable agricultural system. Please identify the following sources of information and their level of importance to your farm operations using the scale provided. The scale is read as follows:

5.....Very important
4.....Important
3.....Moderately important
2.....Less important
1.....Not Important at all

EXAMPLE: "Mass media"..........1 2 3 4 5

SOURCES	LEVEL OF IMPORTANCE
(1)...Magazines	1 2 3 4 5
(2)...Radio	1 2 3 4 5
(3)...Television	1 2 3 4 5
(4)...Post office mail	1 2 3 4 5
(5)...Office visits	1 2 3 4 5
(6)...Bulletins	1 2 3 4 5
(7)...Newsletters	1 2 3 4 5
(8)...Meetings	1 2 3 4 5
(9)...Ag. Career Days	1 2 3 4 5
(10)...State fairs	1 2 3 4 5
(11)...Meetings	1 2 3 4 5
(12)...Workshops	1 2 3 4 5
(13)...Seminars	1 2 3 4 5
(14)...Newspapers	1 2 3 4 5
(15)...Demonstrations	1 2 3 4 5
(16)...Agricultural shows	1 2 3 4 5

SECTION (B) "Decision Making"

DIRECTION:

Please indicate the level of influence the following agencies have on your day-to-day decision making on issues concerning your farm operation. Use the scale of 1-5 below and circle the appropriate number selected.

5.....Very high
4.....High
3.....Moderate
2.....Low
1.....Very low

EXAMPLE: "Government agencies".......1 2 3 4 5

1. Farmers' Home Administration...............1 2 3 4 5
2. Soil/water Conservation Service............1 2 3 4 5
3. Agricultural Extension Service.............1 2 3 4 5
4. Agricultural Research Service..............1 2 3 4 5
5. Agricultural Stabilization Service.........1 2 3 4 5
6. Farm Bureau............................... 1 2 3 4 5
7. Private scientists (consultants)...........1 2 3 4 5
8. Department of Commerce, Iowa...............1 2 3 4 5
9. Agricultural Experiment Station............1 2 3 4 5
10. Farmers' Cooperatives......................1 2 3 4 5
11. Agribusiness companies.....................1 2 3 4 5
12. College/University staff (researchers).....1 2 3 4 5

PART IV

SECTION (A) "MARKETING OUTLET"

In marketing your farm products how likely are you to use any of these sources. Through which of these outlets are your farm products likely to be sold. Use the scale provided to indicate your likelihood of using these outlets.

5.....VERY LIKELY
4.....LIKELY
3.....EVEN CHANCES
2.....UNLIKELY
1.....VERY UNLIKELY

1.....Government agencies..............	5	4	3	2	1
2.....Agribusiness companies...........	5	4	3	2	1
3.....Farmers Cooperatives.............	5	4	3	2	1
4.....Feed Companies...................	5	4	3	2	1
5.....Private individuals..............	5	4	3	2	1
6.....Neighbors........................	5	4	3	2	1
7.....Local Food stores................	5	4	3	2	1
8.....Roadside sales...................	5	4	3	2	1
10.....Grain Elevators..................	5	4	3	2	1
11.....Customers at your home...........	5	4	3	2	1

PART V

DEMOGRAPHIC INFORMATION"

Direction:

Please circle the letter which best describes your situation. Please circle only one or fill in the blank where necessary.

1) Gender:
   (1) Male
   (2) Female

2) Your age (in years): ________________

3) Marital status:
   (A)________Single
   (B)________Married
   (C)________Number of children if (B)

4) Please place a check mark ( ) in the blank provided to identify the type of farm operation(s) applicable to you; check all items which are applicable to you.

____________ Full Time farmer
____________ Part time farmer
____________ Farm owner
____________ Tenant farmer
____________ Rent your farm
____________ Farm on contract basis
____________ Have a part time job
____________ Employ additional labor
____________ Use on the family labor

5) Indicate the number of years of education you have completed: Please circle only one number.

..1..2..3..4..5..6..7..8..9..10..11..12..13..14..15..16..17..18..

6) Your annual net income (in thousands of dollars) ranges from:

   (A) 10,000 or below
   (B) 10,001 to 20,000
   (C) 20,001 to 30,000
   (D) 30,001 to 40,000
   (E) 40,001 or above

7) How many years have you been operating a farm? ______________years

8) What percentage of your farm input financial resources do you allocate to these items in your farming operation?

1.....Farm equipment......................._____________
2.....Fertilizer (all types)..............._____________
3.....Seed................................._____________
4.....Feed (for livestock)................._____________
5.....Chemicals (pesticide & herbicides)..._____________
6.....Labor................................_____________

TOTAL.....100%

9) Would you like to receive a summary report based on this questionnaire?

___________YES ____________NO

The time you spent on this questionnaire is appreciated.

Thank you for your cooperation.

APPENDIX B. FOLLOW-UP CORRESPONDENCE

1·8·8·8 Centennial 1·9·8·8
IOWA ♦ STATE ♦ UNIVERSITY
Agriculture & Home Economics
EXPERIMENT STATION

Department of Agricultural Education
201 Curtiss Hall
Ames, Iowa 50011
515-294-5872

TITLE: EDUCATIONAL IMPLICATIONS FOR INTEGRATED CROP AND LIVESTOCK FARMING SYSTEMS RESEARCH AND DEVELOPMENT (FSR&D) IN IOWA

Dear ....,

We are still expecting to receive the questionnaire we mailed to you two weeks ago. We know that this is a busy time for you and most farm operators.

We provided information about the study at the front page of the questionnaire. The study is about farming systems in Boone and Story counties of Iowa. This is a group study. It has little to do with individual farmers.

We ask you to exercise some urgency by mailing the questionnaire as soon as possible. We have received many questionnaires back. But yours is greatly needed. If you have already mailed yours kindly ignore this note. But if it is still on your desk, please complete it and mail it to us.

We are enclosing another questionnaire per chance you misplaced the first one. As we wait to hear from you, feel free to call the individuals below for further information.

Thank you.

Alan Kahler

Dr. Alan A. Kahler
(Professor, In-charge of study)
(515) 294-0894
(8am to 4pm)

Fidelis N. Ubadigbo
(Graduate Student)
(515) 296-8016
(6pm to 12 midnight)

APPENDIX C. HUMAN SUBJECTS APPROVAL FORM

INFORMATION ON THE USE OF HUMAN SUBJECTS IN RESEARCH
IOWA STATE UNIVERSITY
(Please follow the accompanying instructions for completing this form.)

1.) Title of project (please type): EDUCATIONAL IMPLICATIONS FOR INTEGRATED CROP AND LIVESTOCK FARMING SYSTEMS RESEARCH AND DEVELOPMENT (FSR&D) IN IOWA

2.) I agree to provide the proper surveillance of this project to insure that the rights and welfare of the human subjects are properly protected. Additions to or changes in procedures affecting the subjects after the project has been approved will be submitted to the committee for review.

FIDELIS NJIDE, UBADIGBO	12-4-88	F.N. Ubadigbo
Typed Named of Principal Investigator	Date	Signature of Principal Investigator

801 PAMMEL COURT, AMES, IOWA 50010	296-8016
Campus Address	Campus Telephone

3.) Signatures of others (if any) | Date | Relationship to Principal Investigator

Signatures of others (if any)	Date	Relationship to Principal Investigator
Alan A. Kahler	12-4-88	MAJOR PROFESSOR

4.) ATTACH an additional page(s) (A) describing your proposed research and (B) the subjects to be used, (C) indicating any risks or discomforts to the subjects, and (D) covering any topics checked below. CHECK all boxes applicable.

- ☐ Medical clearance necessary before subjects can participate
- ☐ Samples (blood, tissue, etc.) from subjects
- ☐ Administration of substances (foods, drugs, etc.) to subjects
- ☐ Physical exercise or conditioning for subjects
- ☐ Deception of subjects
- ☐ Subjects under 14 years of age and(or) ☐ Subjects 14-17 years of age
- ☐ Subjects in institutions
- ☐ Research must be approved by another institution or agency

5.) ATTACH an example of the material to be used to obtain informed consent and CHECK which type will be used.

- ☐ Signed informed consent will be obtained.
- ☒ Modified informed consent will be obtained.

6.) Anticipated date on which subjects will be first contacted: Month 12 Day 20 Year 88

Anticipated date for last contact with subjects: 01 31 89

7.) If Applicable: Anticipated date on which audio or visual tapes will be erased and(or) identifiers will be removed from completed survey instruments: NA Month Day Year

8.)

Signature of Head or Chairperson	Date	Department or Administrative Unit
David L. Williams	12/12/88	Ag. Education

9.) Decision of the University Committee on the Use of Human Subjects in Research:

☒ Project Approved ☐ Project not approved ☐ No action required

George G. Karas	12-16-88	
Name of Committee Chairperson	Date	Signature of Committee Chairperson